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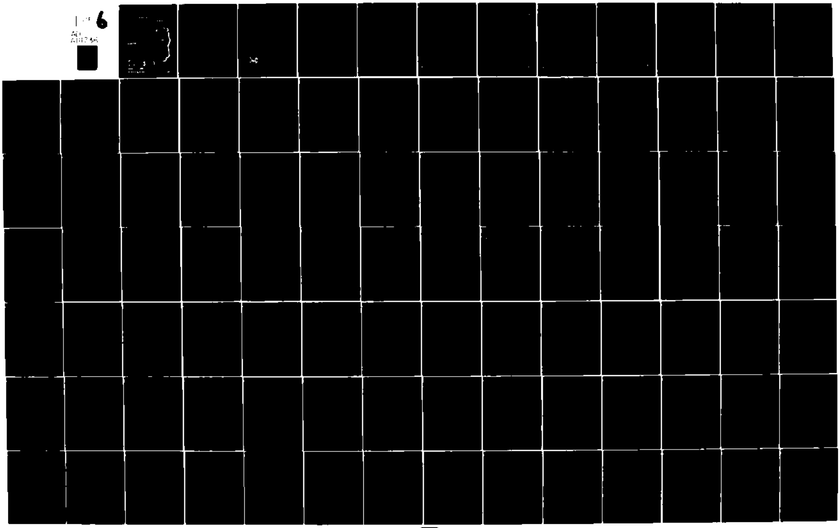

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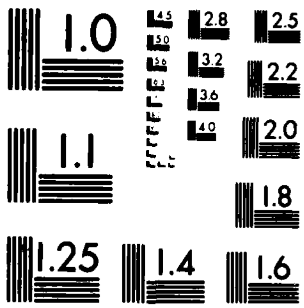

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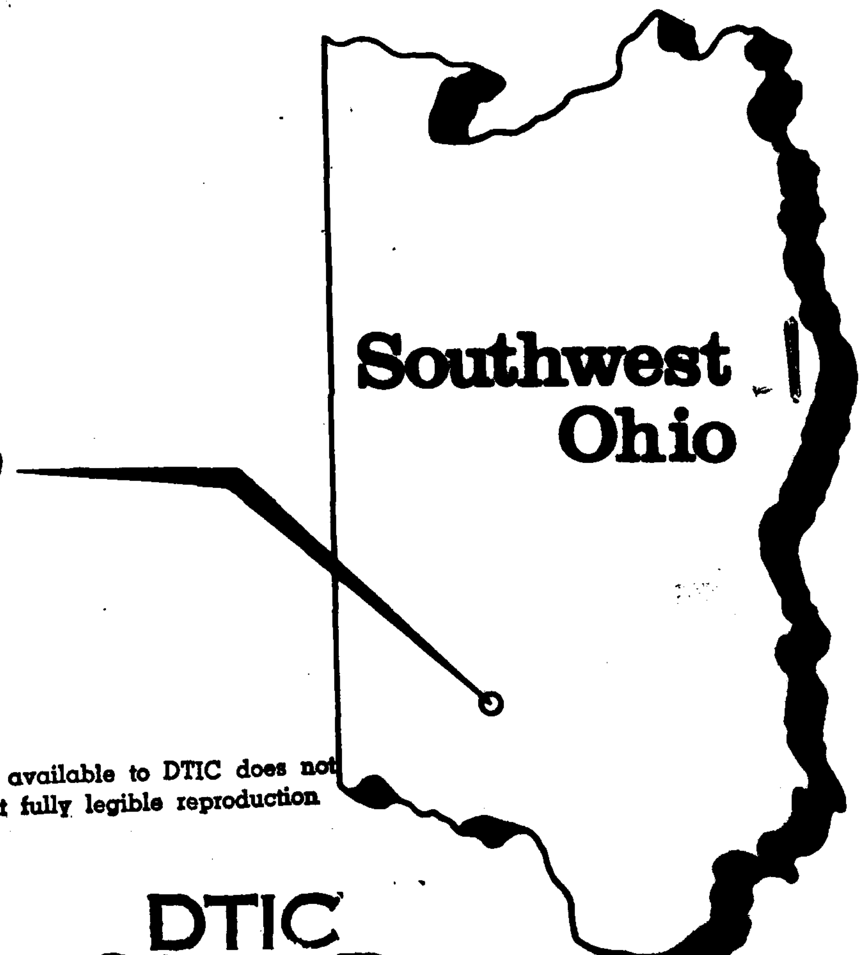

Water Resources Development

October 1981

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INTERIM REPORT FOR WATER RESOURCES DEVELOPMENT MIAMI RIVER, LITTLE MIAMI RIVER, AND MILL CREEK BASINS SOUTHWEST OHIO

A Study to Determine the Feasibility of Providing Flood Control and Related Water Resources Improvements in the Pleasant Run Basin, Ohio

Volume 2 of 2

October 1981

INTERIM REPORT FOR WATER RESOURCES DEVELOPMENT MIAMI RIVER, LITTLE MIAMI RIVER, AND MILL CREEK BASINS

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PROBLEM IDENTIFICATION

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PROBLEM IDENTIFICATION

INTRODUCTION

The purpose of this appendix is to present background information relating to the study and to present information pertaining to planning constraints, planning objectives, and specific data on projections and analyses to the extent necessary to identify problems and opportunities.

STUDY AUTHORITY

The authority for this study is contained in two resolutions, namely the U.S. Senate Resolution of 31 May 1967 and the U.S. House of Representatives Resolution of 19 October 1967. The resolutions read as follows:

> RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE UNITED STATES SENATE, That the Board of Engineers for Rivers and Harbors, created under Section 3 of the Rivers and Harbors Act, approved June 13, 1902, be, and is hereby requested to review the report of the Chief of Engineers on the Comprehensive Flood Control Plan for the Ohio and Lower Mississippi Rivers, published as Flood Control Committee Document Numbered 1, Seventy-fifth Congress, and other pertinent reports, with a view to determining whether any modifications of the recommendations contained therein are advisable at the present time, with particular reference to consideration of improvements for flood control, water

> quality control, water supply, recreation, fish and wildlife, and other purposes, in a plan of development of the water resources in the Miami River, Little Miami River, and Mill Creek Basins in Southwestern Ohio.
>
> RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE HOUSE OF REPRESENTATIVES, UNITED STATES, That the Board of Engineers for Rivers and Harbors is hereby requested to review the reports of the Chief of Engineers on the Comprehensive Flood Control Plan for the Ohio and Lower Mississippi Rivers, published as Flood Control Committee Document Numbered 1, Seventy-fifth Congress, and other pertinent reports, with a view to determining whether any modifications of the recommendations contained therein are advisable at the present time, with particular reference to consideration of improvements for flood control, water quality control, water supply, recreation, fish and wildlife, and other purposes, in a plan for development of the water resources in the Miami River, Little Miami River, and Mill Creek Basins in Southwestern Ohio.

The resolutions direct a review of prior reports with a view to determining whether improvements for flood control and allied purposes are advisable at the present time in the Miami River, Little Miami River, and Mill Creek Basins in Southwestern Ohio.

SCOPE OF THE STUDY

The authorizing resolutions directed the study to encompass the Miami River, Little Miami River, and Mill Creek Basins in Southwestern Ohio. Such a study includes consideration of water resources in the vicinity of Fairfield, Ohio--Pleasant Run Creek, High School Tributary, General Motors (GM) Ditch and East Fork Tributary. This report discusses in detail the present and projected water-related problems and needs at Fairfield and considers alternatives for appropriate solutions, and presents a plan of improvement determined to be the best available. The study includes field investigations, hydrologic investigations, economic studies, and coordination with Federal, State, and local governmental units, as well as conservation, environmental, and

interested citizens groups. These studies were made in depth and detail deemed sufficient to permit the comparison of alternative plans, and the selection of the most suitable plan.

STUDY PARTICIPANTS AND COORDINATION

Comments and inputs were requested from agencies having primary responsibility for information in specific areas. Coordination was maintained with the City of Fairfield, the Miami Conservancy District (MCD), the U.S. Fish and Wildlife Service, and the State of Ohio.

Prior to August 1979, meetings with local and state officials were held in June 1975 (at the initiation of the study) and in November 1977 at Fairfield. As a result of the 1 August 1979 flood at Fairfield, increased interest from local citizens in the Banker Drive and Crystal Drive areas resulted in the formation of a group known as the August 1st Alliance. This group has been working with the City of Fairfield and the Miami Conservancy District (MCD) in an effort to solve the flooding problem. Between August 1979 and June 1981 numerous field trips have been made to the study area in an effort to develop a better understanding of the problems and needs of the community. Seven meetings between Corps and MCD personnel have been held to coordinate information gathered for this study and seven meetings in addition to the Stage 2 Plan Formulation Meeting have been held with the City of Fairfield to explain the status of the study. Also, two meetings have been held with the August 1st Alliance.

The Stage 2 Plan Formulation Meeting was held at Fairfield on 20 November 1980. Of the 50-55 persons in attendance, only one resident objected to any type of flood control improvements--fearing that flows would be increased downstream causing his private bridge to be washed out. The great majority of the persons present either were members of the August 1st Alliance or the City Council. Support for a plan involving dry bed reservoirs upstream was strongly voiced because it would

control upstream flows and would disrupt the existing community to a lesser degree than would a "channel only" plan. The major concern expressed at this meeting was the length of time to begin construction and the cost of the project.

The concerns and views of the above participants have been incorporated into this study. Appropriate letters from these participants and the draft report from the U.S. Fish and Wildlife Service are included as exhibits.

STUDIES BY OTHERS

The only prior study pertaining to specific flood problems at Fairfield was a brief reconnaissance report prepared by the Miami Conservancy District in 1967. A report prepared by the Corps in July 1973 titled "Southwestern Ohio Survey Investigation Phase I Report" was made to determine in what areas further flood control studies were needed. One of these areas was Fairfield.

Since the flood along Pleasant Run Creek in Fairfield in August 1979, the City of Fairfield employed the Miami Conservancy District to investigate solutions to flood control problems in the Pleasant Run area. A preliminary report dated 14 December 1979 and a detailed report dated October 1980 were prepared by MCD. The October 1980 report recommended that if a plan was adopted by the City of Fairfield that, "the plan, which from the point of view of the District staff produces the most benefits and raises the fewest social or environmental issues, is the combination of reservoirs A, C, and D with some limited channel work at the bridges and upstream from Nilles Road."

REPORT PROCESS

The completion of this report will finish the preauthorization studies in the area. The main report, environmental impact statement (EIS), and these appendices provide the documentation for further review and action by Federal and State decision makers. More specifically, the report will be transmitted to and reviewed by the following: Corps of Engineers--Ohio River Division, Board of Engineers for Rivers and Harbors, and Chief of Engineers; Secretary of the Army; Office of Management and Budget; and Congress. The above process includes additional steps to obtain further inputs from the general public and local, State, and Federal agencies. Upon completing this review, the Division Engineer will issue a public notice to all persons known to be interested in the study. The notice sets forth the findings of the study and invites those, who wish to do so, to furnish their views and comments to the Board of Engineers for Rivers and Harbors. Depending upon the views and comments received and upon controversial matters, the Board may hold a public meeting during its review of the report. The Chief of Engineers forwards copies of the report to the Governor of Ohio and to other interested Federal agencies for formal review and comments. After receipt and consideration of all comments including the review by the Office of Management and Budget, the Secretary of the Army transmits the report to Congress for action.

The above-described review process generally takes 1 year for completion. Congress would then act on the report. Assuming a project is authorized, Congress would then appropriate funds for advanced engineering design and construction. The total process from completion of this report to a theoretical completion of construction, under favorable conditions, would take about 6 years, or until about 1987.

NATIONAL OBJECTIVES

The formulation of plans is directed to meeting current and projected problems and needs so that improved contributions are made for National Economic Development (NED) and Environmental Quality (EQ). The general objectives for formulating plans are those presented in Senate Document No. 97, 87th Congress, the National Environmental Policy Act of 1969, Section 122 of the Rivers and Harbors Act of 1970, and other pertinent laws.

EXISTING CONDITIONS

NATURAL RESOURCES AND MAIN FEATURES

The study area is located in the south-central part of Butler County, with one small area in the upper reaches of Pleasant Run Creek extending southward into Hamilton County. The drainage area of Pleasant Run Creek and its tributaries covers 14.2 square miles. Pleasant Run is tributary of the Miami River and has its confluence with the Miami at River Mile 30.7. The Miami River flows from north to south toward the Ohio River.

The flood plain of the study area is highly urbanized with relatively small open space and greenbelt strips. In pursuit of open land for housing, industry and commerical activity, developers have utilized much of the suitable land. In order to control urban growth concentration, the Miami Valley Regional Planning Commission (MVRPC) and planning commissions of surrounding communities have made land use plans which allocate areas of future urban growth and areas in which intensive land development would be discouraged. These plans also prescribe open space criteria which could maintain sufficient open areas for recreation.

Topography

The area is characterized by two distinct types of surface configuration, the uplands which consist of low rolling hills and the valley bottoms which are broad and nearly level. The uplands have been dissected by small drainage ways so that relatively few level sections remain. The slopes over most of the uplands are moderate to steeply rolling. The slopes range from vertical bluffs in areas which rock outcrops to long, more gradual slopes rising to an elevation of 200 feet or more above the valleys. Most of the valley walls have a slope between 10° and 20°.

The valley bottoms, which include the stream flood plains and terraces or benches, are flat or nearly flat except where channels, sloughs, or steep faces of the benches occur. The Miami River is the major drainage system in the area and flows diagonally across Butler County from northeast to southwest. Natural surface drainage is good except on a comparatively few small upland flats.

Geology

The area is underlain by bedrock of sedimentary origin. Interbedded shales and fossiliferous limestone of upper Ordovician age underlie most of Butler County. Silurian age limestone is the uppermost bedrock in the remainder of the latter two counties. The Ordovician limestone is the Richmond Group which typically consists of hard, dense, fossiliferous limestone 1 to 5 inches thick interbedded with a soft clay like shale which has a distinctive robin's egg blue color.

The area has experienced at least two glacial stages, the Illinoian and the Wisconsin. Glacial drift laid down by the glaciers is up to 100 feet deep on top of the bedrock over most of the upland areas. It is deepest in the valleys and is shallow or absent on steep slopes. All of the glacial material in the area was laid down during the Wisconsin age which was the last glacial stage. Material from the Illinois glacier

had largely eroded away prior to the Wisconsin stage. Till is a homogenous mixture of clay and stones and lacks stratification. Till of Wisconsin age weathers to a yellowish-brown to dark silty clay loam. The lower unoxidized layers are hard, tough, and relatively impermeable. During glacial retreat, meltwater flowed down the valleys filling them with vast quantities of sand and gravel called outwash. Besides till and outwash deposits, silts settling out of lakes and pools and wind blown silt deposits or loess are the glacial deposits which explain the characteristic topography and soils of the area.

Soils

The soils in the area are formed predominantly of parent materials from the Wisconsin glacial age. This type of parent material consists of glacial till, outwash, loess, and lacustrine deposits. In some areas where the glacial drift had eroded away, soils formed in residum weathered from the underlying bedrock. In the flood plains, some soils formed from alluvium deposited by the streams in flood stages.

The Russel, Miami, Xenia, Celina, Fincastle, Crosby, and Ragsdale soils are examples of soils formed in till or loess of variable thickness. The Eldean, Ockley, Warsaw, and Wea soils formed in deposits of sand and gravel glacial outwash and Uniontown, Henshaw, and Patton soils formed in silty or clayey lacustrine deposits. Genesee, Ross, Eel, Shoals, Landes, and Lanier soils formed in loamy or sany alluvial deposits.

The soils at the study area are alluvial and terrace soils. Alluvial soils are formed from material washed from higher areas and deposited on the flood plains. They do not have well developed topsoil and subsoil layers as do most upland soils, but often have alternating layers of fine and coarse materials. These soils are generally very productive since sediments rich in plant nutrients, organic matter, and lime are added periodically by floodwaters. This group of nearly level soils usually is not subject to surface erosion. However, streambank

and channel erosion sometimes occurs during periods of flooding. Much of these soils are subject to annual flooding which makes them unsuitable for certain types of agricultural use in spite of their productivity. Because of the severe flood hazard, these soils are generally not suitable for development unless protected by levees.

Most terrace soils are formed over fairly well sorted stratified sand and gravel from glacial outwash deposits. The terraces occur as raised areas between the stream flood plains and the uplands. Terrace soils are usually high enough above the present stream flood plains to escape annual flooding. The depth of the underlying gravel and sand is very important as soils with a depth of less than 42 inches to sand and gravel have low moisture supplying capacity and are subject to drought.

Borings were made at each of three potential dry bed reservoirs - Sites "A," "C," and "D." The locations of each of these sites are shown on Plates B-11, B-12, and B-13 in Appendix B. The borings indicate the following conditions at each site:

- Site "A." Bedrock is shale with interbedded thin limestones of the Ordovician Age. Overburden consists of glacial deposits of silty to sandy clay and sands. Ground water is shallow - approximately 5 feet below ground surface in the abutments. The shallow ground water will require dewatering treatment in both the valley cutoff trench and in the spillway excavation. Borrow material should be readily available upstream of the embankment from the valley or abutments although additional borings will be made to verify this during advanced engineering and design.

- Site "C." The borings encountered soft shale on the right abutment at about 20 feet below ground surface. Bedrock is shale of Ordovician Age. Bedrock was not encountered in borings in the valley. Overburden consists of glacial clays with occasional thin sand and silt lenses. Blow counts in the valley borings indicate medium stiff clays below 15 to 20 feet. Some settlement can be expected under

the embankment in these clays. Ground water indications in the borings show the water table to be at about 8 feet below ground surface on the abutment and 20 feet below in the valley. Borrow material for the embankment should be available upstream in the valleys and on the abutments although additional borings will be made during advanced engineering and design.

- Site "D." Bedrock is not encountered in the valley or on the right abutment. The bedrock is shale with interbedded limestone of Ordovician Age. Overburden encountered is glacial clays with silt and sand lenses. Ground water in the valley is indicated to be about 10+ feet below ground surface in wet, loose sand and silt. Excavation of an inspection trench will require dewatering. Some settlement can be expected under the embankment in the soft to medium stiff clays encountered in the borings. Borrow material for the embankment should be available upstream of the damsite in the valley and on the abutments although additional borings will be made during advanced engineering and design.

Climate

The area lies in the humid temperate continental climatic zone. This climate is characterized by large annual and daily changes in weather and temperature as a result of passing fronts and associated high or low pressure centers. Normal average daily temperatures in the study area vary from 33° F in January, the coldest month, to 76° F in July, the warmest month. Winters are moderately cold with temperatures dropping near 0° F, while summers are warm with temperatures occasionally rising above 90° F. Prevailing winds are from the southwest with average velocities reaching 8 to 11 miles per hour. Damaging winds of 30 to 80 miles per hour occasionally occur during spring and summer in close association with thunderstorm activity.

The annual precipitation over the area averages 39 inches, with most of this occurring during the winter and spring months. Although

droughts do occur, rains are usually quite adequate for normal crop growth. Thunderstorms, which occur on the average of 50 days per year, produce most of the area's high intensity rainfalls. Spring rains, which sometimes can persist for several days, will delay tillage or cause flooding when soils are frozen or saturated.

Surface and Ground Water

The flow that is equaled or exceeded [illegible] percent of the time is near the minimum flow recorded in most [illegible] streams and is generally considered to come primarily from ground water discharge. The amount of ground water discharge is largely dependent on the natural storage properties of the formations within a drainage basin. A river flowing from a basin in impermeable rock would experience a flood following every substantial rain and would carry little or no flow a few hours later. A river with the same mean flow but flowing over an area of thick, permeable sands and gravels would have a slight increase in flow after a rain and high sustained flows between rains. In the Miami River Basin, the storage is for the most part in glacial outwash deposits and is ground water storage. The utility of water is determined as much by its chemical quality as by its availability and quantity. Natural water from all sources contains varying quantities of dissolved solids which, if present in high concentrations, may render the water unsatisfactory for certain uses. Western Ohio is underlain predominantly by limestone bedrock which is overlain by glacial drift derived primarily from limestone. As a result, both surface and ground water contain relatively high concentrations of calcium and bicarbonate. The streams in the area are subject to pollution from industrial and municipal waste water discharges as well as nonpoint source discharges from agricultural activities and malfunctioning septic systems. The water quality of an individual stream varies according to its assimilative capacity and the amount of stress to which it is subjected.

Glacial outwash deposits which comprise the valley fill of the Miami River system are the predominant source of ground water in the

area. All but a tiny fraction of the ground water used for industrial and municipal purposes is obtained from these deposits. The typical industrial and municipal wells drilled in the valley fill deposits, in the Dayton area, range in depth between 60 and 200 feet and yield from 100 to 3,000 gallons per minute. By comparison, consolidated rocks and till deposits are relatively unimportant sources of ground water in the area. Till deposits are relatively impervious and wells drilled in them generally supply less than 10 gallons of water per minute. The limestone bedrock underlying the till is a poor source of water. Of the two major limestone systems in the area, the Silurian supplies the most water. The Brassfield limestone will usually provide a sufficient supply of water for farm and home use.

Recreation

Fairfield is located in a surburban area adjoining Hamilton, Ohio, in Butler County, on the border of Hamilton County about 10 miles from Cincinnati. In 1970, there were 14,680 people living in Fairfield, and the population increased to 30,816 people by 1980. Also, it is projected that there will be 48,300 people in the City by the year 2000. For recreation planning, a population of about 43,000 people in the year 1990, or about 14,500 households, will be used for determining recreation demands. Governmental services, such as parks and recreation, seldom are able to keep in step with rapidly expanding populations. Consequently, there is a significant need for all sorts of recreational opportunities. However, Butler County is generally well supplied with day-use recreational facilities as shown in the State Comprehensive Outdoor Recreation Plan (SCORP). Only bicycling and picnicking show a positive need. Playgrounds and outdoor games will be needed in Fairfield to satisfy neighborhood demand even when there may be an excess of facilities in the planning unit. Furthermore, it should be noted that there is a significant need for hiking facilities in Hamilton County which adjoins the Fairfield area.

Environmental and Cultural Resources Assessment

The original vegetation of the study area consisted of a beech-maple climax forest. In this association, beech is usually the most abundant canopy tree, while sugar maple dominates the understorv. Typical constituents of this association besides beech and maple include tulip poplar, white ash, red elm, American elm, black cherry, hackberry, walnut, basswood, buckeye, white oak, shagbark hickory, and bitternut hickory. The drier ridges in the area were occupied by oak-hickory communities and the streams, which have well developed flood plains, have lowland communities consisting of more hydric species such as silver maple, boxelder, cottonwood, willow, and sycamore. The forest cover has been cleared from most of the study area for agricultural purposes. The remaining forest cover is generally confined to narrow margins along the stream corridors and to scattered sites in the uplands which are unsuitable for agriculture due to steepness of slopes or unsatisfactory soil conditions.

Despite the extensive clearing for agriculture, the area supports a relatively diverse fauna. Terrestrial species occupy numerous and varied microhabitats available within the area. The availability of different food sources and the presence or absence of transitional zones between vegetation types with differing physical characteristics further affect faunal distribution. The wooded areas support the greatest abundance of species despite contributing the least community space in the area. The vegetational diversity of these areas provides abundant acorns, nuts, fruits, seeds, etc. upon which small animals and various birds feed. The wooded areas also provide favorable habitat for a number of reptiles and amphibians. The pasture and old field communities provide habitat for skunk, rabbit, woodchuck, fox, and oppossum.

Specific biotic communities encountered along Pleasant Run included: old and cultivated fields, woodlot, and riparian flood

plain. Old, abandoned pastures utilized for grazing purposes and cropland fields of corn and soybeans comprise an approximate 12 and 18 percent, respectively, of these communities. These habitats predominate along the lower stream reaches of Pleasant Run and the upper stem of the High School Tributary. Woodlot and riparian flood plain vegetative communities entail approximately 6 and 64 percent of the habitat, respectively. The extensive diversification exhibited by both woodlot and flood plain communities reflect hydric bottomland conditions. Dominant vegetation within these natural communities were water tolerant tree species of sycamore, boxelder, and willow. Other canopy species in these communities include buckeye, elm, beech, black locust, hackberry, walnut, and silver maple. The most prevalent shrubs and vines composing the understory were dogwood, wildrose, honeysuckle, and grape. The herbaceous plants identified in the old field areas include milkweed, goldenrod, thistle, wild carrot, burdock, teasel, wild onion, and dandelion. Flood plain vegetation at certain locations along the stream in the study area extended some 40 feet back from either side of the watercourse.

The riparian forest provides food, cover, and nesting sites for a variety of wildlife. Despite its urban location, Pleasant Run has many natural characteristics which provide suitable habitat for a diversity of wildlife species. The area supports a number of birds such as crown, mockingbird, starling, house sparrow, cardinal, song sparrow, robin, red winged blackbird, and grackle. Small mammals found in the area include squirrel, raccon, rabbit, oppossum, woodchuck, bats, mice, fox, and skunk. Reptiles and amphibians noted in the area are garter snake, box turtle, toads, salamanders, frogs, and mudpuppys. The physical characteristics of the stream are adequate to support a diverse fishery although the stream is stressed somewhat by intermittent flows and degraded water supply. The sand and gravel substrate of the stream has a sufficient gradient to maintain a good pool-riffle complex. Based on a survey by the U.S. Fish and Wildlife Service, the following fish

species are found in Pleasant Run: smallmouth bass, bluegill, green sunfish, black bullhead, white sucker, creek chub, stoneroller, and carp.

The Miami River Valley is rich in terms of prehistoric archeological sites, particularly in the number of mounds which the area contains. In Fairfield Township, for example, there are 17 recorded mounds, seven enclosures, and one prehistoric cemetery. This area has not been under recent settlement since the 18th century. Fertile soils and flat to gentle topography made this area a major agricultural region in the early 19th century. To provide improved transportation to agricultural markets, the Miami and Erie Canal was built, which led to a manufacturing boom. The Miami valley is one of the more important industrial areas of the United States.

Four mounds and one enclosure have been recorded in the Pleasant Run flood plain. The enclosure is located on the Pleasant Run streambank in the vicinity of Groh Lane. Due to excavation of these sites and the intensive development in the area, these sites have been destroyed. There are no sites in the project area listed on the National Register of Historic Places. An archeological reconnaissance of the project area revealed no prehistoric or early historic remains.

HUMAN RESOURCES

Demographic Data

Butler County had a 1970 population of 226,207. Approximately 6.5 percent of this population, or 14,680, lived in the City of Fairfield. Demographic data for Butler County and Fairfield indicated that between 1970 and 1980, there was a population increase to 258,380 in the county and to 30,816 in the city, representing a change of 14 percent and 110 percent, respectively. This population will increase to 294,700 in the county according to OBERS and to 48,309 in the city by the year 2000 according to several projections quoted by Burgess and Niple, Consulting

Engineers 1/ for the City of Hamilton and by Vogt, Sage, and Pflum (VSP) 2/ for the City of Fairfield. The projected population changes of 14 percent for the county and 57 percent for the city, between the years 1980 and 2000, far exceeds the anticipated rates of change in Ohio and the Nation during the same period. According to the U.S. Census, the population of the City of Fairfield was 9,726 and the population of Butler County was 199,076 in 1960.

Population density was 548 per square mile in Butler County and 1,495 per square mile in Fairfield in 1980 based on the given population figures for that year and the land areas, which are 471 square miles in the county and 20.6 square miles in the city.

By the year 2000, population density in the county and the city, assuming no change in the land areas, would be 625 per square mile and 2,345 per square mile, respectively.

The increase in population between 1970 and 1980, in both county and city, and the projected increase to the year 2000 reveals the potential of favorable employment and income conditions.

During the period 1970 to 1980, there was a significant increase in the population group below age 5, although the birth rate was declining and a substantial increase in the 20-44 and 65+ age groups. These shifts were due to migration movements. Such population shifts indicate that population projections for Butler County as quoted above are reasonably credible. Population shifts as such indicate a likely movement from large cities in the region to small cities such as Fairfield and also a rural to urban movement. Such movement would inevitably require rapid residential and commercial development resulting in a

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1/ Burgess and Niple, Consulting Engineers, Draft Environmental Impact Statement for Hamilton, East Multipurpose project, at the City of Hamilton, Ohio, August 1979, page 31.

2/ Vogt, Sage, and Pflum, Community Development Plan for the City of Fairfield, 1978.

resulting in a substantial growth in population density, loss of vacant and agricultural land, and significant population losses in nearby big cities and rural areas.

Education

Butler County experienced a fairly strong growth in educational activity from World War II through the 1960's. However, between 1970 to 1975, public school enrollment decreased in the County as follows:

Public School Enrollment

	1970	1975	Percent Change
Butler County	51,990	50,825	-2

Source: U.S. Census Bureau, County and City Data Book, 1977

Decrease in public school enrollment has been a general phenomenon in many parts of the nation since the early 1970's. By 1970, the average number of school years completed by persons 25 years and older in Butler County was slightly below the State average.

School Years Completed (Persons 25 and Older) 1970

	Up to 5 Years (Percent)	4 Years High School or more (Percent)	4 Years College or more (Percent)
Butler County	3.8	41.2	8.5
State of Ohio	3.5	53.2	9.3

In comparison, Fairfield had 57.9 percent high school graduates and 9.4 percent college graduates among persons 25 years and older in 1970, but in 1980 completion of high school and college education increased to 66 percent and 16 percent, respectively, among persons 20 years and older, as estimated by VSP.

Educational activity in the study area is characterized by a significant increase in the proportion of females and blacks in public school enrollment. Generally, traditional education in high school and college level liberal arts is preferred although the main occupational emphasis is on vocational and technological training.

Health

The availability and accessibility of health care facilities, manpower, and equipment are essential to alleviating problems and attending to needs. Although the study area exhibits no significant health problems or needs which are not common to the State of Ohio, health planning entities in the region emphasize the need for strengthening health education, especially in the area of occupational health and safety, and the need for a strong program of prevention of disease including immunization, early detection and diagnosis, treatment, and rehabilitation.

In 1975, Butler County had a death rate below that of the State and the birth rate was also lower than that of the State.

In 1975 Butler County had 231 physicians, or one physician per 1,060 people, and 1,159 hospital beds, or one bed per 211 people.

The availability and accessibility of nursing home and emergency services are generally adequate, although problems exist. The Health Systems Agency in the region, a creation of the National Health Planning Act of 1974, cooperates with the local, regional, and State health planning and health services delivery entities to alleviate problems of availability, accessibility, and cost of health care.

DEVELOPMENT AND ECONOMY

The economy of Bulter County is characterized by strong activities in manufacturing and a moderate shift from the production of goods to services. Butler County produces goods for export above the national

average and goods for local consumption below the national average. Recent industrial activity indicates that the production of goods for local consumption is increasing, while the production of export goods is not declining except in the percentage of total production. Meanwhile, services in general, and finance, insurance, and real estate in particular, have achieved a phenomenal growth.

In the past, manufacturing provided both the leading portion of jobs and the leading portion of wages. Today, while manufacturing still provides the leading portion of wages, services and wholesale and retail trade provide the majority of jobs.

Agricultural activity has experienced a moderate decline in farm employment in Butler County.

In general, the economy of the Hamilton-Middletown Standard Metropolitan Statistical Area (SMSA) (Butler County), has been growing much faster than the economy of the Southwest Ohio region whose growth trails behind the economic gowth in the Nation due to geographic shifts of industrial activity and employment from eastern parts of the Nation to other parts.

Economy and Labor Force

Although the economy of the Hamilton-Middletown SMSA is considered developed and mature, the economy of Fairfield exhibits dynamic features typical of a growing economy with a development potential for sustaining the employment and income needs of an expanding labor force and a growing population, while the manufacturing sector is expected to absorb a smaller percentage of the labor force than in the past, it will continue to be the leading source of income and will provide additional employment opportunities, although at a growth rate lower than those expected for service activities and wholesale and retail trade. The greatest percentage increase in employment will occur in services connected with transportation, communications, utilities, science and

technology, finance, home repair and maintenance, real estate and insurance, professional, clerical, and administrative services, and vocational education.

However, towards the end of the 20th Century, the economy of this area will be typically mature, as opportunities for further development become saturated due to the exhaustion of developable land.

Employment

Between 1970 and 1977, employment increases occurred in Butler County as indicated in Table A-1.

TABLE A-1

TOTAL EMPLOYMENT BY COUNTY, STATE, AND
UNITED STATES AND PERCENT CHANGE (1970-1977)

Area	1970	1971	1972	1973	1974	1975	1976	1977	1970-77 Percent Change
Butler	85,639	84,340	86,958	90,646	92,284	89,262	92,727	96,809	13.03
Ohio (000)	4,155	4,129	4,262	4,422	4,477	4,278	4,361	4,500	0.08
U.S. (000)	79,627	79,120	81,702	84,409	85,936	84,783	87,485	90,564	15.2

During the period 1970-1977, Butler County had a total employment incease of 13 percent. The City of Fairfield had a total employment increase of over 100 percent during the 1970's. The labor force in Fairfield increased from 5,837 persons in 1970 to 13,078 in 1977 and is projected to be 26,000 by the year 2000 according to VSP. Labor force growth was above the corresponding rates of change anywhere in the State.

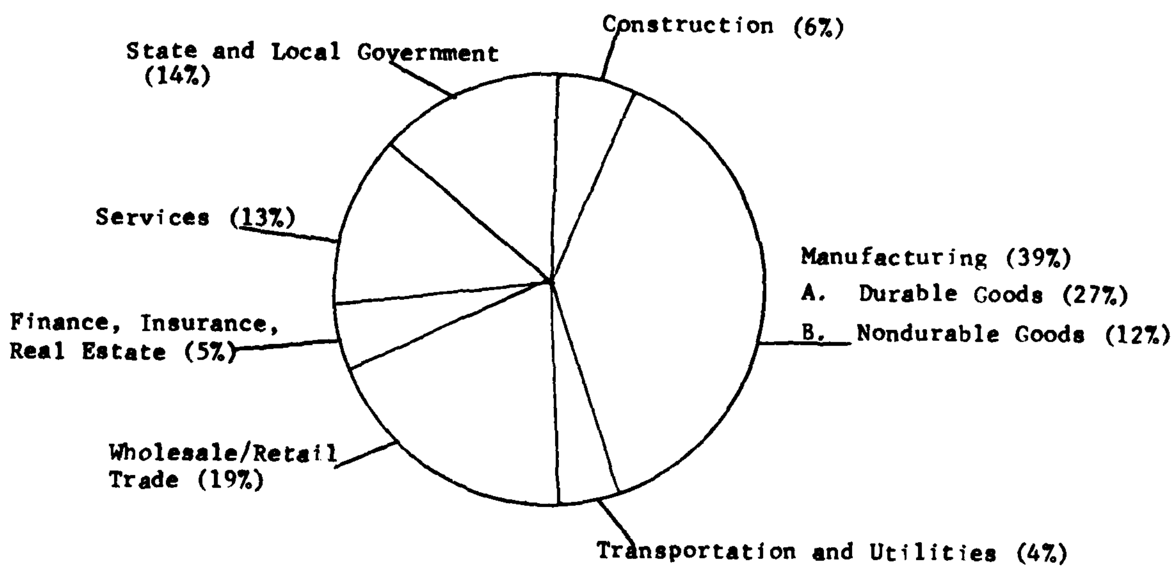
Percentage of individuals employed in 1975 in various industrial activities is shown in Figure A-1.

Income

Between 1970 and 1976, per capita income increased in Butler County as indicated in Table A-2.

FIGURE A-1

PERCENTAGE OF EMPLOYMENT BY
INDUSTRIAL GROUP
BUTLER COUNTY, OHIO



Source: Derived from 1975 average county employment data published by Ohio Department of Economic and Community Development.

TABLE A-2

PERSONAL PER CAPITA INCOME AND TOTAL PERCENT INCREASE FOR BUTLER COUNTY, THE STATE OF OHIO, AND THE UNITED STATES (1970-76)

Area	1970	1971	1972	1973	1974	1975	1976	1970-77 Percent Charge
Butler	$3,729	$3,900	$4,101	$4,494	$4,925	$5,252	$5,929	58.9
Ohio	3,949	4,153	4,512	4,973	5,433	5,769	6,409	62.2
U.S.	3,893	4,132	4,483	4,980	5,478	5,851	6,396	64.2

Source: Ohio Department of Economic and Community Development (ODECD) and U.S. Department of Commerce, Bureau of Economic Analysis as quoted by ODECD.

During the 1970-1976 period, the total percent increase in personnel income per capita was below the State and the U.S. average according to data in Table A-2. However, data in the 1977 County and City Data Book (CCDB) of the U.S. Census Bureau, indicated that in 1974 per capita income for Butler County, the State of Ohio, and the United States were: $4,538 for Butler County, $4,561 for Ohio, and $4,572 for the United States. Data in the 1977 CCDB also indicated that the 1970 median family income was $10,388 for Butler County, $10,309 for Ohio, and $9,586 for the United States. Subsequently, it appears that the average annual percent increases in per capita and median family incomes should be somewhere around those of the State and the U.S. average. In 1980, the median family income was $20,200 in Fairfield, $20,400 in Butler County, $20,283 in Ohio, and $20,500 in the United States, according to HUD income estimated.

Transportation

The City of Fairfield is served by Interstate Highway 275, Ohio Route 4, Bypass 4, and U.S. Highway 127. Railroad service provided by the Chessie Railroad System which has one northbound and one southbound local daily freight. The Chessie main line between Cincinnati and Detroit crosses the city. Fairfield is also a part of the Cincinnati commercial trucking zone which is served by over 100 common carriers. Air transport is available via the Greater Cincinnati Airport which is connected with Fairfield by a 30-mile expressway and via the nearby Hamilton Airport.

Intra-area travel will increase as a result of expansion in employment and population density within the region. The greatest increase in travel will occur in nonwork related trips which usually respond to increasing income, more frequent car ownership, and emphasis on leisure activity. Higher population density tends to increase the number of noncar households and the demand for inexpensive, rapid, public means of transportation. Planning and zoning authorities in

Butler County, the State, and the region have made plans and regulations for providing adequate public transportation systems.

Housing

The City of Fairfield has a housing mix consisting of 66.5 percent single family dwellings, 29.7 percent structures containing two or more units, and 3.8 percent mobile homes. The total number of units was approximately 9,964 in 1978.

Single family dwellings are largely owner-occupied and the structures of five units or more are mostly renter-occupied. The other categories are either renter- or owner-occupied.

A housing shortage already exists in Fairfield. As the city is experiencing strong increases in employment and population, a phenomenal activity in residential land development is inevitable. New housing units have been constructed at a rate of about 700 per year. Yet the increase in the price of land and building materials and the cost of labor tend toward the building of single housing units with prices above the reach of moderate and low income families. The construction of dwellings of the nonsingle family categories, which is increasing, will ease the needs of the lower income groups.

Although there is a strong demand for all types of single and multiple family dwellings, including mobile homes, construction of new single units for upper middle and upper income families predominates and usually matches existing demand. The main gap in all these areas occurs between housing demand and supply for lower middle and lower income families and individuals whose needs could be met by construction of new multiple units and low cost or subsidized single units. There is evidence that low cost housing supply is improving, but is still far from meeting this demand.

CONDITIONS IF NO FEDERAL ACTION IS TAKEN

GENERAL

It is estimated that future development of the study area would be approximately the same with or without project, due to four main reasons. One, planned industrial, commercial, and institutional land use generally avoids flood damage susceptibility by means of zoning for such developments in high areas. Two, the location of the study area within convenient proximity to major highway, railroad, and air avenues of transport would continue to attract new labor-intensive industrial and commercial acitivities. Three, the readily available skilled and semiskilled labor supply of the Hamilton-Middletown SMSA would respond sufficiently to prospective development needs. Four, population growth which would come as a result of the expanding labor market and the traditional migration from rural areas and nearby big cities (Cincinnati and Dayton) would be served by existing land use planning which avoids flood damage susceptibility by zoning for residential development outside the 100-year flood level.

Traditionally, industrial, institutional, and commercial development in the study area was not dependent upon the capability of flood plain land to support economic stability and growth, and this is expected to continue in the future with or without project. The "without" demographic and economic conditions and the relative shortage of developable land manifest a new residential development trend. Onsite inspection and conversation with local developers, planners, realtors and property owners revealed a trend towards the construction of upper income single family units and moderate income multifamily units. New construction of moderate and low income single family units and low income multifamily units would be scarce due to the relatively high price of land suitable for residential development and the high cost of construction. The study area would therefore have a housing shortage for moderate and low income families, especially in view of an anticipated strong population growth. This shortage would prompt

substantial increase in mobile homes and commuting activities from nearby areas where lower and moderate income housing units are available.

In spite of the relative unpredictability of industrial location movements population shifts, and economic conditions, the immediate study are: will experience a strong population growth by the year 2000 as indicated by OBERS population projections for SMSA-92 Hamilton-Middletown, Ohio (Butler County) in Table A-3. As the preliminary estimate of Bulter County population, according to the 1980 Census, was 258,380, the accuracy of OBERS projections for 1980 was 98 percent.

TABLE A-3

OBERS POPULATION PROJECTIONS TO THE YEAR 2000
SMSA-92 HAMILTON-MIDDLETOWN, OHIO (BUTLER COUNTY)

Area	1980	1985	1990	2000
SMSA-92 (Butler County)	254,100	265,100	276,500	294,700

LAND USE

General

Land use patterns in the City of Fairfield indicate the predominance of residential development, where 54.5 percent of all developed land is used for housing. All public uses constitute 33.4 percent of the existing acreage. Industrial and commercial uses are only 12.2 percent. The total of existing developed land is 5,984 acres, of which 3,259 are in residential use, 403 are in commerical use, 324

are in industrial use, and 1,998 are in public uses. The total land area has 12,916 acres of which 6,932 are vacant and agricultural, including some 800 acres which are considered unsuitable for any development due to topographic constraints.

Existing zoning classifications for undeveloped land indicate that 8.6 percent will be in residential use, 6.8 percent in commercial use, 44.4 percent in industrial use, and 40.2 percent will remain in agricultural use or vacant until the existing zoning is changed. However, population and employment growth trends imply that the suitable undeveloped land in the City of Fairfield would be almost completely developed by the year 1995 or before. Table A-4 shows a summary of undeveloped acres by existing zoning classification for the city. Figures 5 and 6 in the Main Report depict the land use of the area for the years 1975 and 2,000, respectively.

TABLE A-4

SUMMARY OF SELECTED UNDEVELOPED AREAS
BY ZONING CLASSIFICATION (ACRES)
EXISTING ZONING, FAIRFIELD, OHIO

Current Zoning Classification	Total Acres	Percent of Total Acres
Agricultural	2,462.1	40.2
Residential	528.8	8.6
Commercial	416.5	6.8
Industrial	2,723.6	44.4
Total	6,131.0	100.0

Source: Vogt, Sage and Pflum, Community Development Plan for the City of Fairfield, 1978, Page B-6.

It is anticipated that the existing zoning will be changed soon in response to the need for additional residential lands. At the rate of about 700 new residential units per year the lands presently zoned for residential use will soon be depleted.

Pleasant Run Drainage Area

Land use in the drainage area of Pleasant Run in Fairfield and northern Hamilton County is characterized largely by existing and planned residential development and unprecedented housing construction activities. Further, existing zoning policies tend to accommodate residential development in the lower areas near the stream and to direct industrial, commercial, and other land uses in the higher areas near transportation routes. Vacant and agricultural land throughout the study area has been viewed as an exhaustible resource requiring careful planning to preclude incompatible and haphazard uses. Residential land use, being the majority of all developed uses (54.4 percent), has been subject to zoning constraints, maintaining that acreage zoned residential at present is expected to be developed before additional acreage is allocated. Since the drainage area is zoned largely residential, it will develop fairly quickly, judging by the rapid increase in housing activity between 1970 and 1980.

It is assumed that the drainage area in Fairfield will be developed by 1995, in view of projected population growth. The population of Fairfield could become 49,914 at a maximum or 45,512 at a minimum, in 1995, as projected by VSP. Given a median growth to 47,713 by 1995, the net increase of 16,879 over the 1980 population would consume about 2,500 residential acres, based on 3 residents per unit and 2.25 units per acre. In early 1978, there were 6,932 acres of undeveloped land in the city, of which about 1,800 were not suitable for development due to topographic constraints. Of the developable acreage of 5,132, about

54.4 [1] percent, or 2,792 acres, would be the logical maximum for total residential use, based on existing zoning trends. About 600 acres of this maximum were already developed during the period 1978-1980, since housing units were built at an average of about 695 units per year. This development leaves a maximum residential balance of about 2,200 acres to meet needs after 1980. Since this balance is considerably less than the 2,500 acres needed, almost all land available for residential development in Fairfield could be developed before 1995 unless development in multifamily housing is emphasized. Subsequently, the assumption that the drainage area will be developed by 1995 is based on the premise that the majority of early housing construction in the city will take place in this area and will lead to other land uses, typically those connected with neighborhood development such as retail and service activities, occurring simultaneously.

Based on available information, there are currently about 1,355 acres of developable land in the drainage area in Butler County. About 90 percent of this land, or 1,220 acres, would be developed for residential use, representing an increase of 2,745 units and 8,235 residents, considering an average of 2.25 units per acre and 3 residents per unit.

It is assumed that the drainage area in Hamilton County in Colerain Township, Springfield Township, Forest Park City and Springdale City will be developed by 1995 as well, judging by the observed growth of housing activity between 1970 and 1980. Housing units were built in these jurisdictions at a total average of 724 units per year since 1970, based on U.S. Census data. If residential development continues at this level, which is likely, by 1995 some 4,826 acres would have been developed (724 units per year x 15 years = 10,860 units; 9,420 units 2.25 units per acre = 4,826 acres). Increase in housing stock during

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[1] Vogt, Sage and Pflum, Community Development for the City of Fairfield, Ohio, 1978, page B-3.

the preceeding decade, as illustrated by data in Table A-5, indicates that most of this development would occur in Colerain Township where the majority of acreage suitable for housing exists outside the drainage area. However, the direction of residential development in all jurisdictions portends that the drainage area would develop significantly faster than other areas. Further, since the drainage area has about 850 developable acres, or about 17 percent of the residential total needed, it could be developed long before 1995, unless multifamily housing is emphasized. Subsequently, the assumption that this drainage area will be developed by 1995 is based on the premise that its future housing activity will be similar to that of the preceeding decade and will lead to other land uses, typically those connected with neighborhood development such as retail and service activities, occurring simultaneously. About 90 percent of developable land in the drainage area, or 765 acres, would be developed for residential use, representing an increase of 1,721 units and 5,164 residents, considering an average of 2.25 units per acre and 3 residents per unit.

TABLE A-5

HOUSING (1970 - 1980)
PLEASANT RUN DRAINAGE AREA IN BUTLER
AND HAMILTON COUNTIES, OHIO

	Housing Units		
Area	1970	1980	Change
Butler County, Fairfield	4,161	11,308	7,147
Hamilton County:			
Colerain Township	13,434	18,153	4,719
Springfield Township	13,620	13,005	- 615
Springdale City	2,300	3,680	380
Forest Park City	3,870	5,626	1,756
Hamilton County Total	33,224	40,464	7,240

Source: U.S. Census, 1980

PROBLEMS, NEEDS AND OPPORTUNITIES

The purpose of this section is to define and discuss the water resource needs and problems in the study area. Investigations indicate that the major problem is flooding and the need to control drainage from upstream development.

No irrigation problems exist in the study area. However, the area along Banker Driver and Crystal Drive have had past problems of water backing up in storm sewers and water backing up in sanitary sewers in homes. The development of hydroelectric power would not be practical due to the size of Pleasant Run Creek and absence of damsites creating a permanent lake.

FLOODING

The Miami Conservancy District and Fairfield officials have had flood problems, the most severe flood occurring on 1 August 1979. The extent of these problems has been identified by developing hydrologic data from this flood and considering such aspects as storm characteristics, stream characteristics, extent and character of the basin and flood plain and projected future characteristics. The hydrologic data were used in developing estimated present and future flood damages.

General Hydrologic Description

The Pleasant Run Basin is located along the Great Miami River and north of the metropolitan area of Cincinnati, Ohio. Suburban growth has occupied much of the Pleasant Run Basin. The remaining area south of Fairfield is rapidly being developed into residential and commercial areas.

Drainage areas and stream slopes are shown in Table A-6.

TABLE A-6

DRAINAGE AREA AND STREAM SLOPE DATA FOR
PLEASANT RUN CREEK AND TRIBUTARIES

Flooding Source and Location		Average Basin Slope (feet/mile)	Drainage Area (square miles)
Pleasant Run at		20.5	
	Mouth		14.2
	River Rd.		13.9
	Nilles Rd.		11.1
	John Gray Rd.		2.88
GM Ditch at		11.1	
	Mouth		1.51
High School Tributary at		32.2	
	Mouth		1.54
East Fork Tributary at		38.5	
	Mouth		3.53

General Storm Characteristics

The storm type causing widespread flooding and especially flooding along the Miami River and major tributaries is the typical Ohio River Basin winter or early spring storm. The storm is usually centered on an axis along the Ohio River valley from southeastern Missouri to western New York. This type storm generally moves up the Ohio River valley in a northeasterly direction and caused the major floods of March 1913, January 1959, March 1963 and March 1964. As was the case in some of the above floods, runoff from this type sotrm is often intensified by antecedent conditions.

Another storm type that generally causes the severest flood conditions on small tributaries, like Pleasant Run at Fairfield, is the severe summer cloudburst. This storm normally has high intensive

rainfall for relatively short duration, which frequently causes flash floods. A storm of this type occurred in Cincinnati on 2 September 1971 when 2.61 inches fell in a 2-hour period and 3.39 inches for the day. Another storm of this type occurred in Fairfield on 1 August 1979, when MCD reported 3.43 inches fell in a 2-hour period in the headwaters of Pleasant Run.

Extent and Character of the Study Area

The flood plain study area is extensively urbanized and extends along Pleasant Run Creek and its tributaries in the City of Fairfield, Ohio. Pleasant Run, a left bank tributary of the Maimi River, is located in Butler County, about 20 miles north of Cincinnati. The area studied, shown on Plate A-1 extends along Pleasant Run from Groh Lane to John Gray (Jackson) Road, a distance of about 5 miles. Pleasant Run tributaries studied include about 3 miles along G.M. Ditch to Dixie Highway, about 0.4 mile along a right bank stream designated as High School Tributary, and about 1.5 miles along a right bank stream designated as East Fork Tributary to Winton Road Bridge.

Nature and Extent of Flooding

Although the study area is subject to backwater flooding from the Miami River, this report focuses primarily on headwater flooding from the drainage areas of Pleasant Run and its tributaries. Two basic types of headwater flooding were evaluated. One type involved conventional flooding as indicated by stream flood profiles. The other type involved evaluation of ponding in lowlying residential areas, which are in some cases considerable distance from the streams. Table A-7 summarizes area, unit, value and damage estimates from recurrence of various flood heights in the study area shown on Plate A-1.

It is expected that the population in the Pleasant Run flood plain study area will not change significantly in the future without or with the project. Based on residential units within the SPF flood plain shown in Table A-7 and 2.7 occupants per unit in Fairfield derived from the 1980 census, flood plain population is estimated at about 3,000.

TABLE A-7

SUMMARY OF AREA, UNIT, VALUE AND PHYSICAL DAMAGES
FROM RECURRENCE OF VARIOUS FLOOD HEIGHTS
1980 DEVELOPMENT AND 1995 NATURAL HYDROLOGIC CONDITIONS
(OCTOBER 1980 PRICE LEVELS)

Stream Reach and Category	Flood Height SPF	500-YR	100-YR	25-YR
Total Study Area				
Area in acres	987	876	722	598
Number Units				
Residential	1,126	1,014	899	682
Commercial	43	37	30	23
Total Units	1,169	1,051	929	705
Property Value ($1,000)				
Residential 1/	73,230	65,800	58,384	46,490
Commercial 1/	6,540	6,060	4,960	4,035
Transportation	10,685	9,185	7,500	4,745
Utility	6,807	6,497	6,209	5,664
Total Value	97,262	87,542	77,553	60,934
Damage ($1,000)				
Residential	9,624.3	8,781.9	6,914.2	4,903.8
Commercial	375.7	317.2	280.3	152.4
Transportation	512.2	419.1	292.8	211.6
Utility	116.7	100.0	84.5	59.2
Total Damage	10,628.9	9,618.2	7,571.8	5,327.0

1/ Includes estimated value of structures, contents and grounds.

DESIRES OF LOCAL INTERESTS

The primary desire of local interests in the study area is relief from flooding. Increased urbanization has resulted in increased flooding and flood damages. The interest of local officials is expressed in Exhibit C-1 in Appendix C. This interest in the flood problems was first expressed in the early 1960's as the Miami Conservancy District made preliminary studies of potential solutions for flood relief.

PLANNING CONSTRAINTS

A portion of the 1936 Flood Control Act, enacted as Public Law 738, 74th Congress, is as follows:

> SECTION 1. It is hereby recognized that destructive floods upon the rivers of the United States, upsetting orderly processes and causing loss of life and property, including the erosion of lands, and impairing and obstructing navigation, highways, railroads, and other channels of commerce between the States, constitute a menace to national welfare; that it is the sense of Congress that flood control on navigable waters or their tributaries is a proper activity of the Federal Government in cooperation with States, their political subdivisions, and localities thereof; that investigations and improvements of rivers and other waterways, including watersheds thereof, for flood-control purposes are in the interest of the general welfare; that the Federal Government should improve or participate in the improvement of navigable waters or their tributaries, including watersheds thereof, for flood-control purposes if the benefits to whomsoever they may accrue are in excess of the estimated costs, and if the lives and social security of people are otherwise adversely affected.

Briefly, the above law establishes two constraints which are: the improvement should have net benefits and the residual condition must not adversely affect the security of the people.

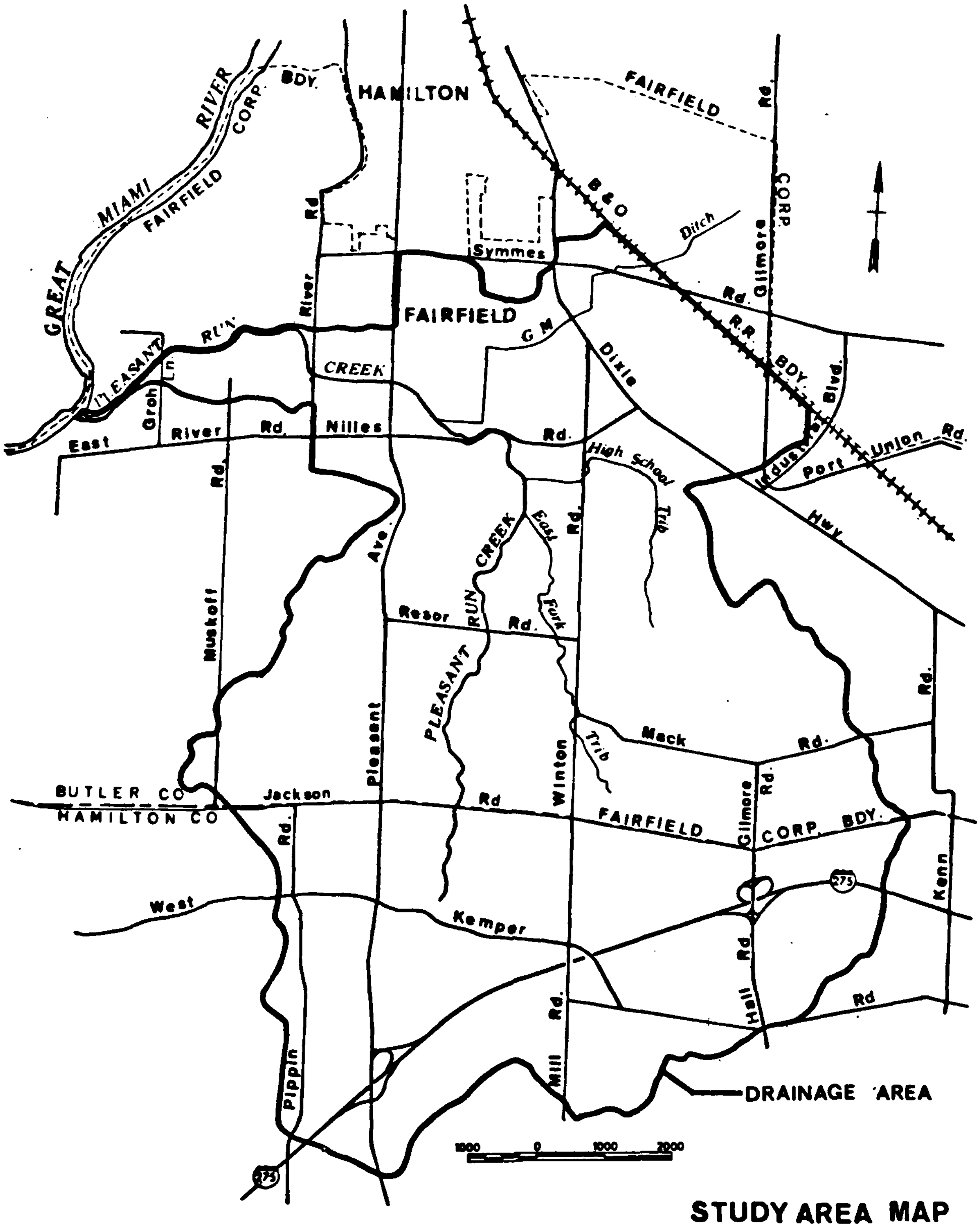
PLANNING OBJECTIVES

Two national objectives have been established for all water resource developments. They are enhancement of National Economic

Development (NED) and Environmental Quality (EQ). NED can be enhanced by improving national economic efficiency. In respect to water resource projects, the most efficient, economical project is the one that maximizes net benefits. EQ can be enhanced by management, conservation, preservation, creation, restoration, or improvement of the quality of natural resources and ecological systems. In order to identify the results of efforts to meet these objectives, an alternative will be formulated which optimizes the NED objective, and an alternative will be formulated to optimize the EQ objective.

The general objectives of this study are to identify the water resource problems in the study area and to develop a range of alternatives to solve or alleviate the problems. As flooding is the major water resource problem in the study area, the specific objective is to identify solutions that address the national objectives while alleviating the flood problem.

APPENDIX A
PLATES



STUDY AREA MAP
FAIRFIELD, OHIO

PLATE A-1

APPENDIX B

FORMULATION, ASSESSMENT AND EVALUATION OF DETAILED PLANS

APPENDIX B

FORMULATION, ASSESSMENT AND EVALUATION OF DETAILED PLANS

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APPENDIX B

FORMULATION, ASSESSMENT AND EVALUATION OF DETAILED PLANS

The purpose of this appendix is to provide the criteria utilized in the formulation process and to provide a logical presentation of the procedure followed to plan selection. This latter procedure evolves sequentially from initial screening of possible alternative solutions, to further consideration of worthwhile plan components, and to impact assessment and evaluation of detailed plans. Emphasis is given throughout the process to retaining those plan components that realistically represent solutions available for public choice.

PLAN FORMULATION

The array of possible flood control measures and plans can be divided into two general categories. Measures to modify damage susceptibility are those that modify, move, or restrict structures in the flood plain. These measures are generally referred to as nonstructural as they do not involve major construction undertakings. The other category consists of structural measures which either reduce the flood stage or physically limit the areal coverage of the flood. These measures

involve the construction of levees, channel improvements, retarding structures, multipurpose reservoirs, or combinations. Detailed cost estimates for the alternatives are presented in Appendix E. The measures and plans considered are discussed below.

PLAN FORMULATION RATIONALE

The process of plan formulation is conducted with the goal of developing plans that meet the stated objectives. However, in order to formulate plans that can be implemented, the formulation process considers certain criteria. The cumulative consideration of these criteria is the rationale for formulating plans. The major criteria are provided below:

- The plans must be acceptable to the public.
- The plans must be able to function reliably and consistently in meeting the objectives.
- The plans should furnish a high degree of protection and not develop residual conditions which may cause adverse impacts to the health and lives of the affected public.
- The plans should be equitable in the distribution of benefits and any disadvantages.
- The plans must show that combined beneficial NED and EQ effects outweigh combined adverse NED and EQ effects.
- The plans must not seriously degrade nor destroy valuable environmental or cultural resources.

SCREENING STUDIES

The primary desire of local interests within the study area is relief from flooding. Increased urbanization has resulted in increased

flooding and flood damages even with stricter zoning ordinances. Increased development in upstream reaches, which will further compound the problem, is inevitable. In the formulation of plans, it was necessary to identify the realistic alternatives available to address the planning objectives, and to screen those alternatives to identify the plans best responding to the planning objectives.

Nonstructural Measures

The commitment to nonstructural alternatives has been addressed by both the President in his Executive Order 11988 and by Congress in the formal legislation of the Disaster Protection Act of 1973 and the Water Resources Development Act of 1974. The 1973 legislation took a significant step toward the implementation of the nonstructural approach by encouraging and requiring the purchase of flood insurance and by requiring the use of land regulation controls for the purpose of flood damage reduction. The 1973 act called for controls for the purpose of flood damage reduction. The 1974 act called for the explicit consideration of nonstructural measures in Federal water resource planning. Section 73(a) of this act requires that, "In the survey, planning, or design by any Federal agency of any project involving flood protection, consideration shall be given to nonstructural alternatives to prevent or reduce flood damages including, but not limited to, flood proofing of structures; flood plain regulation; acquisition of flood plain lands for recreational, fish and wildlife, and other public purposes; and relocation with a view toward formulating the most economically, socially, and environmentally acceptable means of reducing or preventing flood damages."

Measures which are designed to control floodwaters--reservoirs, levees, channel modifications, and diversions--protect both existing and future flood plain development. For nonstructural measures, however,

some measures are designed principally for existing structures, and some principally for preventing future growth in flood damages. The screening study considered the following nonstructural measures.

Raise-in-Place. The theory of the alternative is that major damages begin to occur to structural units and their contents as floodwaters reach and exceed the first floor elevation whether or not the structure has a basement. By raising the structure (first floor) above the particular flood level, it would be possible to eliminate all or a great part of potential flood damages.

Evacuation of Flood Prone Structures. This alternative concerns flood damages to structures located in the flood plain which can be eliminated by acquisition of flood prone properties, assisting the residents in finding safe and decent housing and tearing down or otherwise removing all flood prone structures, and converting the flood prone areas to uses more compatible with the risk of flooding.

Relocation of Flood Prone Structures. The theory of this alternative is that, rather than destroy or dismantle for materials those structures located in the flood plain and subject to flooding, consideration be given to moving or relocating such units out of flood prone areas. Some units may be located within the flood plain but relocated above pertinent flood levels.

Installation of Flood Proof Closures. Structures with exterior walls constructed of brick, brick veneer, concrete, and cement block are relatively impermeable and can be made more so by sealing exterior surfaces. Similarly, basement walls are usually of concrete or cement

block and basement floors of concrete and therefore relatively impermeable. Structures of these types of materials are particularly suited to keeping out water and the only adjustments necessary are to minimize seepage through walls and floors with sealants and temporarily or permanently closing doorways and windows. Structures constructed of wood, aluminum, sheet metal, or masonite on either a wood or steel frame are generally permeable and difficult to keep water out. Similarly, structures on raised foundations with wood flooring are much more permeable than concrete slab-on-grade.

Construction of Small Walls and/or Levees around Structures. Individual walls and/or levees are not considered feasible for residential protection due to the great number of structures involved.

Relocation or Protection of Damageable Property within an Existing Structure. Since significant damages are a result of basement flooding, consideration was given to relocating the major items normally found in the basement and subject to damage. Those items include the heating-air-conditioning equipment, water heater, and laundry facilities. A preliminary evaluation of space requirements for the facilities to be relocated indicated that few, if any, houses could accommodate such a relocation. In many cases, the type of furnace utilized in a basement installation is completely different from that used in a ground floor installation and would require extensive modification or replacement to effect a relocation. The water heater and laundry facilities would not pose such significant problems but would require revised plumbing connections for the hot, cold, and drain piping and the dryer vent. No further consideration was given to this alternative.

Control of Flood Plain Development. Restriction of development in the flood plain is desirable to curtail the growth of damageable property in the flood plain. Various methods of control are available to the community planners such as zoning ordinances, subdivision regulations, and building codes. Zoning ordinances regarding flood plain development are a requirement of the Flood Insurance Program. Zoning ordinances, whether a part of the Flood Insurance Program or not, provide a means of prohibiting, limiting, or controlling residential, commercial, and industrial development in or near the flood plain with the view to minimizing potential flood damages. Subdivision regulations are aimed specifically at one major type of development which, due to a scarcity of other suitable land, often finds its way into the flood prone areas. Subdivision regulations, combined with building code requirements calling for damage-resistant materials, offer significant opportunities for both the city and county zoning commissions to reduce future flood damages by restricting development. Additional discussion concerning zoning provisions required by the Flood Insurance Program is presented under that heading.

Costs associated with implementing zoning ordinances, subdivision regulations, and building codes include costs for obtaining basic engineering data, for drafting and adopting a regulation and possible loss of tax revenue. Loss of tax revenue would result from the prohibition of use or limitation of use of areas in the flood plain.

Utilization of these procedures is seen as an alternative that can be implemented by local authorities. No further consideration is given with the exception of the Flood Insurance Program requirements.

Flood Forecasting, Flood Warning, and Evacuation System. Flood forecasting, flood warning, and flood evacuation are strategies to respond to a flood threat. These strategies include the following:

- A system for early recognition and evaluation of potential floods,
- Procedures for issuance and dissemination of a flood warning,
- Arrangements for temporary evacuation of people and property,
- Provisions for installation of temporary protective measures,
- A means to maintain vital services,
- A plan for post-flood reoccupation and economic recovery of the flooded area.

Systems for early recognition and evaluation of potential floods are generally of two types: those for flooding of major stream systems and those related to flash floods. The National Weather Service (NWS) has 13 river forecasting centers and 82 river district offices located throughout the United States. Generally, their forecasts predict stages on major river systems such as the Miami River and would be valuable in alerting property owners and residents to the threat of backwater flooding along the river.

Headwater flooding in the Pleasant Run Basin, however, is more of the flash flood variety as noted by the relatively short time of concentration for the study reach of 5 to 6 hours. Flood warning is the critical link between forecasts and response. An effective warning process will communicate the current and projected flood threat, reach all persons affected, account for the activities of the community at the time of the threat (day, night, weekday, weekend), and motivate persons to action. An effective warning needs to be followed by an effective response. This means effective and orderly evacuation of people and property.

The factors which determine the physical feasibility of forecast, warning, and evacuation measures are somewhat different from those which determine the physical feasibility of many other nonstructural measures. The feasibility of most other measures is directly related to the type structure and depth of flooding. Forecast, warning, and evacuation feasibility are more dependent upon hydrologic, social, and institutional factors. The feasibility of forecasting depends upon the size of the drainage area; whether the river is a main stem or tributary; travel time; and other hydrologic factors which influence the ability to make reliable forecasts. Small watersheds generally have short response times, making it especially difficult for warning to be helpful. Such is the case with the Pleasant Run Creek Basin.

Tax Incentives. Tax incentives can be used as a measure to control flood damages in two ways. By the use of a tax reduction, an owner may be encouraged to preserve the flood plain, to provide open space, preserve agricultural lands, and meet other objectives as part of the community's planning goals. Also, tax surcharges may be utilized to influence a development pattern by making flood plain lands and their subsequent urbanization economically unattractive. Several states now have specifically authorized tax incentives for open space use.

Based on the age of structures and the high percentage of flood plain lands already developed for residential purposes, tax incentives would be effective over the long term but would be relatively ineffective in the short term. Conversion of currently developed lands to open space or recreation areas would require some 50 plus years.

Flood Insurance. Flood insurance is unique among all other measures considered in that it does not directly reduce flood damage to either existing or future development, but rather indemnifies a policy

holder for financial losses suffered during a flood. Federally subsidized flood insurance with a Government subsidy of up to 90 percent was made available for existing flood plain uses by the National Flood Insurance Act of 1968. The act required that communities adopt land use controls meeting the Department of Housing and Urban Development (HUD) standards as a prerequisite for subsidized insurance.

The 1973 amendments materially changed the entire concept of the original program by making it virtually compulsory rather than voluntary. The act provides that, within communities which have identified flood hazards, property owners eligible for flood insurance from FIA must purchase such insurance or lose eligibility for Federal assistance for construction and acquisition in the identified flood plain. This includes bank loans and mortgage insurance. Eventually, Federally subsidized flood insurance will not be available unless the community adopts land use regulations meeting FIA's standards.

Flood insurance is viewed as a measure which an individual property owner may use to "solve" a flood problem. It may be the preferred alternative--preferred over temporary closures, raise-in-place, relocation, or any other measures.

In other portions of this report, economic feasibility was evaluated by comparing cost with damage reduced. In the case of flood insurance, damage is not reduced by taking out a policy; consequently, it is never economically feasible when evaluated in this way. Flood insurance, like fire insurance, is taken out for a variety of reasons, most of which are associated with risk and security. By paying a small premium, a property owner can be covered for a full-range financial loss.

A flood insurance study has been completed for Fairfield, Ohio, and the community has adopted land use control measures. Since the proceedings for flood insurance are completed, further consideration of flood insurance as a nonstructural alternative is not considered necessary.

Structural Measures

Structural measures to reduce the frequency of flooding to existing improvements were considered for Pleasant Run Creek and its tributaries. The major areas of concern were the Crystal Drive and Banker Drive areas (Reach PR-6) where a high concentration of damages occur. Alignments and quantity estimates are generally from mapping based on 2-foot contour intervals with some supplemental field notes and cross sections.

Channel Enlargement. Channel enlargement usually involves widening and straightening in order to improve the hydraulic carrying capacity of the stream. Typically, channelization requires the construction of a trapezoidal channel. Usually all cover, obstacles, and irregularities within the stream are removed as well as streamside vegetation. The effect on associated terrestrial and aquatic wildlife can be severe, often with little opportunity for recovery, particularly considering continued maintenance activities required for the channel and side slopes.

Channel enlargement lowers flood heights and results in significant long-term flood damage reduction, increased property values, and enhances the security and general welfare of flood plain residents. Associated health problems experienced during flooding are either eliminated or reduced. Additionally, channel enlargement would reduce the anxiety associated with unexpected flood occurrences and the inconveniences associated with temporary disruption of employment, community services, transportation, utilities, and other community

amenities and services. Channel modification would also reduce temporary isolation of residents during flooding.

Floodwalls and Levees. Floodwalls and levees preclude floodwaters from entering damage susceptible areas. Detrimental impacts associated with floodwalls and levees are similar to those associated with channel improvement except that streambank vegetation removal is usually avoided or greatly reduced, and most detrimental impacts on the aquatic environment are avoided. Borrow excavation for material to construct levees can induce adverse impacts, particularly if required impervious material can be found only in environmentally sensitive areas. Beneficial impacts associated with floodwalls and levees are also very similar to those of channelization except that they are usually intensified by the high degree of protection provided by floodwalls and levees.

Dry Bed Reservoirs. Reservoirs reduce flood levels by holding back peak flood flows until downstream conditions permit release. They can also be effective in fulfilling some fish and wildlife and recreational needs.

Floodwater Diversions. Diverting floodwaters away from damage centers can be a very effective measure as long as induced damages are not significant. Usually in order to be practical, the topography has to be conducive to relatively short and shallow diversion channels. Diversion channels usually leave the main stream and have environmental impacts similar to levee plans. When all flood flows are diverted, the plan reduces downstream flooding very similar to a dry bed reservoir. A review of available mapping for potential diversion channels resulted in

no potential plans. The only scheme appearing possible is to divert flows to Mill Creek; however, the severe flood problems in lower Mill Creek negate this possibility.

Conclusions

Of the measures identified, some are clearly more responsive than others to the specified planning objectives for this study. To avoid development of less viable alternative plans and to keep those alternative plans evaluated in detail at a manageable number, those management measures considered to be clearly less responsive to the planning objectives were eliminated from further consideration. The measures eliminated from further consideration were building code regulations and tax reform. In addition, no attempt was made to incorporate zoning or flood insurance in any alternative plans because these two measures were assumed to be a part of the "without" conditions. Thus, the measures of raise-in-place, evacuation, relocation, flood proofing, channel enlargements, floodwall and levees, and dry bed reservoirs remained for consideration in development of alternative plans.

ANALYSIS OF PRELIMINARY PLANS

In the early planning stages, a wide range of plans was considered for alleviating the flood problems. This section provides a brief description of each plan, a comparative assessment and evaluation of the plans, and concludes with identification of those plans to be studied further.

Brief Description of Preliminary Plans

Raise-In-Place

This alternative would physically raise the first floor of houses to provide 100-year flood protection. A total of 790 housing units are located within the inundation limits of the 100-year flood and are considered in the evaluation of this alternative. Of this total, 86 units are susceptible to major flood depths, that being more than 1-foot of water in the first floor living area.

A benefit-cost analysis of this alternative indicated that the alternative was economically infeasible.

Aside from the nonfeasible benefit-cost ratios, a negative aspect of this alternative would result from the isolation of protected dwellings in flood areas. Those homes would be surrounded by floodwater from both hazardous depths and/or velocities, and would create hazards in terms of medical, fire, and law enforcement emergencies.

Evacuation of Structures from Flood Plain

A detailed benefit-cost analysis for permanent evacuation of the entire 790 total units was conducted. This analysis, for the 100-year frequency flood level, showed both the with recreation and the without recreation variations of the alternative to be economically infeasible by a wide margin.

Computation of costs for this alternative includes those costs associated with land acquisition, relocation of the family, movement of household goods, and incidental expenses. Other financial costs are the

relocation assistance provided under Public Law 91-646 available up to a maximum of $15,000 per unit. In addition to the financial costs, acquisition of lands would result in social costs as well, including dislocation effects on the family, destroying the neighborhood along with its sense of social cohesion. It would also require land management action for flood plain lands acquired. However, the unfavorable benefit-cost ratios remove this alternative from further consideration.

Relocation of Flood Prone Structures Out of the Flood Plain

Implementation of this alternative would offer some opportunity to mitigate the disruptive effects upon neighborhood community cohesion. However, the unfavorable benefit-cost ratio removes this alternative from further consideration. Additionally, relocation of flood prone structures would be somewhat hampered by the geography and severely hampered by existing development patterns of the area.

Flood Proofing

This alternative would prevent water from entering structures up to a 100-year level of protection by installation of permanent and/or semipermanent closures and waterproofing measures. This can be accomplished by sealing exterior surfaces and placing aluminum or steel flood shields over openings prior to a flood. Of 790 units, 674 units were considered to be flood proofable. However, since the success of this type of protection depends upon the length of time the owner has to install the shields and the fact that the benefit-cost ratio was infeasible in every reach except PR-6, this alternative was deleted from further study.

Channel Enlargements

Initial alternatives for channel enlargement began at Mile 0.6 (Groh Lane) on Pleasant Run and extended upstream to Mile 0.67 on GM Ditch, to Mile 0.66 on High School Tributary, and to Mile 3.52 on Pleasant Run (see Plate B-1). Levels of protection investigated ranged from a 10-year plan to a 100-year plan and considered various types of construction including earth channels, riprap and gabion channels, and concrete channels. These various levels of protection and types of construction were reviewed in order to identify the land and property requirements and, therefore, neighborhood and social impacts as well as cost effectiveness. Although initial studies indicated an economically feasible plan existed which would protect Pleasant Run as well as the tributaries, Stage 2 level design, cost estimates, and hydrology studies indicated such a plan was not economically feasible.

The resulting channel enlargement plans which were subjected to more detailed design, cost, and benefit analysis were as follows.

25-Year Channel Plan

Channel enlargement to contain the future 25-year frequency flood flow would extend some 2.92 miles from Reach PR-2 through PR-6 (see Plate B-2). Channel widths would vary from 70 feet to 100 feet, with depths ranging from 9 to 14.5 feet. Construction would include riprapped banks and some vertical concrete wall sections designed to prevent the removal of any homes or structures. Bridges at East River Road, Pleasant Avenue, and Nilles Road would be enlarged.

35-Year Channel Plan

Enlargement of the channel plan to accommodate the future 35-year frequency flood would extend the same length, with widths varying from 5 to 10 feet greater than the 25-year plan. Channel depth and bridge enlargements would be the same as for the 25-year plan. Again, channel construction is a combination of riprapped banks and concrete. See Plates B-4, 5 and 6 for the location of this plan.

100-Year Channel Plan

Enlargement of the channel alternative to accommodate the future 100-year frequency flood event would maintain all physical factors and bridge replacements as previously described, except that channel widths increase an additional 25 to 50 feet.

Dry Bed Reservoirs

Dry bed reservoirs, also called retarding or detention structures, were investigated in detail for several reasons. Dry bed reservoirs may be able to provide equivalent degrees of protection at lower cost and may be able to significantly reduce the environmental and social impacts associated with other alternatives and thereby increase the chance of actual implementation. The reservoir sites also have the potential to meet future recreation needs. Following are four plans involving dry bed reservoirs. The location of each of these dry bed reservoirs is shown on Plate B-3. Dry bed reservoirs A, C and D are shown on Plates B-11, B-12 and B-13, respectively.

Four Dry Bed Reservoirs Plus Channel Enlargement to Provide 35-Year Protection The drainage area upstream of PR-6 was investigated for possible reservoir sites. Initially, some five sites were screened to four for cost and benefit analysis. These four sites are shown as Sites A, C, D, and E on Plate B-3. In trying to keep costs at a minimum, by not relocating any apartments (except at Site "A") or major roads, the reservoirs were sized to provide an optimum plan. The design objective was to limit design discharge at Nilles Road to 3,700 cubic feet per second (Corps 35-year degree of protection).

In all reservoir studies, whether a plan involves one, two, three, or four reservoirs, some channel enlargement work is required to provide the desired degree of protection. As the number of reservoirs considered decreases, the amount of required channel enlargement work increases. The objective of looking at one, two, three, and four reservoir plans is to define the economic feasibility and cost effectiveness versus tradeoffs with environmental and social impacts, i.e., the greater the reservoir storage, the less reduction of backyards along the stream due to channel enlargement requirements.

Three Dry Bed Reservoirs Plus Channel Enlargement to Provide for 35-Year and 100-Year Protection In an effort to determine if some combination of reservoir and channel enlargement provided a more optimum solution, the tradeoff between number of reservoirs and channel enlargement was evaluated further.

Dry bed reservoir Sites A, C, and D were retained and evaluated. The 35-year plan requires 0.83 miles of channel widening in Reach PR-6 and the 100-year plan requires a total of 1.37 miles of channel widening

in Reaches PR-3, 4 and 6. See Plates B-7, 8, 9 and 10 for the location of the channel enlargement for this plan.

Two Dry Bed Reservoirs Plus Channel Enlargement to Provide for 35-Year and 100-Year Protection For this evaluation, Sites C and D are retained and the length of channel enlargement extends from Reaches PR-3 through PR-6, a distance of 2.56 miles. Channel width varies from 50 to 130 feet for the 100-year protection and from 40' to 120' for the 35-year protection.

One Dry Bed Reservoir Plus Channel Enlargement to Provide for 35-Year and 100-Year Protection The final combination evaluates reservoir Site D with the 2.92 miles of channel enlargement in Reaches PR-2 through PR-6, having widths from 75 to 210 feet.

Floodwall and Levee

This plan, providing flood protection for a 500-year flood, was studied for the Crystal Drive-Banker Drive area in Reach PR-6. A plan was also considered for other areas along Pleasant Run Creek, but was not given detailed consideration. Levees must be designed to insure against the dangers of overtopping and would require major channel enlargement or levees on the opposite streambank in order to eliminate induced flooding. Because of the limited area available for construction and because of induced damages, this plan was considered infeasible.

Floodwater Diversion Channels

There were essentially no practical alternatives for diverting flood flows from the middle or upper part of the Pleasant Run drainage area to other receiving streams. Diversion plans were therefore given no detailed consideration.

Three Dry Bed Reservoirs Plus Nonstructural Measures to Provide 100-Year Protection

Combining different plans or plan elements can, at times, result in the best overall plan for water resource development. In keeping with the desire of the local sponsor to provide the maximum protection possible and cause as little disruption as possible, a combination plan consisting of dry bed reservoirs at Sites A, C and D was considered with evaluation, relocation and flood proofing to provide a 100-year degree of protection to Fairfield.

Comparative Assessment and Evaluation of Preliminary Plans

The previous paragraphs presented a brief review of each plan considered in the preliminary planning stage. These plans were then compared and evaluated in order to screen out the unproductive plans. The criteria used in the screening process generally relate to meeting the planning objective. Values used for comparability and evaluation purposes included: total first cost, benefit-cost ratio, flood damage reduction, residual damages, public acceptability and pertinent remarks. Table B-1 presents a summary of the results of the comparative assessment and evaluation of nonstructural and structural plans, respectively. It provides the basis for selecting those plans which best meet the planning objective.

TABLE B-1

EVALUATION OF PRELIMINARY PLANS

Alternative Plans (Total Estimated First Cost) 1/	Economic Feasibility	Percent Damage Reduction	Remaining Damages	Public Views and/or Remarks
Raise-in-Place ($2,100,000)	Unfeasible - 0.10 B/C	4	$1,030,000	Not effective; only about 10 percent of homes can be raised; not acceptable to local sponsor
Evacuation ($58,700,000)	Unfeasible - 0.16 B/C	100	--	Not effective; not acceptable to local sponsor
Relocation ($70,000,000)	Unfeasible - 0.46 B/C	100	--	Not effective; not acceptable to local sponsor
Flood Proofing ($5,710,000)	Unfeasible - 0.21 B/C	91	99,000	Not acceptable to local sponsor; not effective
25-Year All-Channel Plan ($9,800,000)	Feasible - 1.02 B/C	82	198,000	Not effective for control of upstream runoff; not preferred by local sponsor
35-Year All-Channel Plan Plan K ($10,300,000)	Feasible - 1.02 B/C	82	190,000	Not effective for control of upstream runoff; not preferred by local sponsor
100-Year All-Channel Plan ($12,130,000)	Unfeasible - 0.87 B/C	82	185,000	Not effective for control of upstream runoff; not acceptable to local sponsor
4-Dry Bed Reservoir Plan 35-Year Protection	Feasible - 1.2 B/C	98	26,000	Site "E" not available; not acceptable to local sponsor

TABLE B-1 (Continued)

Alternative Plans (Total Estimated First Cost) 1/	Economic Feasibility	Percent Damage Reduction	Remaining Damages	Public Views and/or Remarks
3-Dry Bed Reservoir Plan Plan H - 35-Year Protection ($10,340,000)	Feasible - 1.5 B/C	97	$ 37,000	Local sponsor interested; upstream runoff is contolled
3-Dry Bed Reservoir Plan Plan J - 100-Year Protection ($11,900,000)	Feasible - 1.3 B/C	97	31,000	Higher degree of protection; more acceptable to local sponsor; upstream runoff controlled; disturbance to property owners will be minimal
2-Dry Bed Reservoir Plan 35-Year Protection ($12,000,000)	Feasible - 1.2 B/C	96	48,000	Large amount of channel work; is not preferred by local sponsor
2-Dry Bed Reservoir Plan 100-Year Protection ($12,900,000)	Feasible - 1.12 B/C	97	40,000	Large amount of channel work; is not preferred by local sponsor
1-Dry Bed Reservoir Plan Site "D" 35-Year Protection ($13,200,000)	Unfeasible - 0.92 B/C	87	136,000	Large amount of channel work; is not preferred by local sponsor
Floodwall and Levee ($1,951,000)	Unfeasible - Not quantified, but cost exceeds potential benefits	Not quantified; appears 50 percent or less	Not quantified; appears 50 percent or greater	Limited area available for construction; not acceptable to local sponsor
Diversion Channel (Not quantified)	Unfeasible - Not quantified, but cost exceeds potential benefits	Not quantified; appears 50 percent or less	Not quantified; appears 50 percent or greater	Not practical; not acceptable to local sponsor

TABLE B-1 (Continued)

Alternative Plans (Total Estimated First Cost) 1/	Economic Feasibility	Percent Damage Reduction	Remaining Damages	Public Views and/or Remarks
Dry Bed Resevoirs with Nonstructural Measures - Plan I, 100-Year Protection ($16,600,000)	Feasible - 1.03 B/C	98.5	$16,000	Nonstructural measures are not preferred by local sponsor

1/ Cost does not include recreation features except in nonstructural measures.

Conclusions

The data in Table B-1 provides sufficient justification for eliminating several of the preliminary plans. The nonstructural plans all have a less than unity benefit-cost ratio and are, therefore, eliminated. The four dry bed reservoir plan, two dry bed reservoir plan, and one dry bed reservoir plan are not considered to be sufficiently implementable to warrant further investigation. The most economically feasible plan is the three dry bed reservoir plan with 0.83 miles of channel enlargement in Reach PR-6. This plan shows a benefit-cost ratio of 1.5. A review of Table B-1 shows other alternatives warranting further studies. The alternatives are the 35-year all-channel plan, 100-year three dry bed reservoir plan plus 1.37 miles of channel enlargement in Reaches PR-3, 4 and 6 and the combination plan involving three dry bed reservoirs with floodproofing evacuation and relocation to provide 100-year degree of protection. All of the above four plans are included in the detailed analysis of plans. Although a combination dry bed reservoir plan with nonstructural measures is not desired by local interests it is considered further as an alternative to the viable structural plans in conformance with President Carter's water policy contained in his message to Congress on 6 June 1978.

A conceptual recreation plan was developed in association with the three dry bed reservoir alternative. This plan is for a community type park with the main recreational activities being picnicking, play areas, jogging and biking trails, and sport fields. The recreation plan is discussed further under Plan Selection of this appendix and is evaluated under Appendix E and discussed in more detail in Appendix F.

ASSESSMENT AND EVALUATION OF DETAILED PLANS

The previous section identified the plans warranting detailed studies. This section will furnish the description, impact assessment, and evaluation of each of the following four plans studied in detail:

(1) All Channel Plan (2.92 miles of channel widening), 35-year protection) - Plan K

(2) Three Dry Bed Reservoir Plan (A, C, D) plus 0.83 mile of channel widening in Reach PR-6 for 35-year protection (Plan H) and 1.37 miles of channel widening in Reaches PR-3, 4 and 6 for 100-year protection (Plan J).

(3) Nonstructural or Combination Plan--Drv bed reservoirs A, C, D plus flood proofing, evacuation and relocation tro provide 100-year protection - Plan I

DESCRIPTION OF DETAILED PLANS

All Channel Plan - 35-Year Protection - Plan K

The all channel plan provides for channel widening along the 2.92 mile length of Pleasant Run Creek from Reach PR-2 through Reach PR-6. (See Plate B-14 for typical sections.) Design details are shown in Table B-2 and detailed costs are shown in Appendix E. The channel is generally trapezoidal with 2 horizontal to 1 vertical riprapped slopes except in two locations where structures adjacent to the creek require the construction of vertical concrete walls. The first location extends from 400 feet upstream of Pleasant Run Bridge to 1,050 feet downstream of this bridge, a total length of 1,450 feet. The other location for a concrete wall is approximately 100 feet upstream and downstream of Nilles Road Bridge, a total length of 200 feet. The plan calls for

replacement of three bridges--at East River Road, at Pleasant Avenue, and at Nilles Road. Several disposal sites to dispose of 585,000 cubic yards of material have been identified and are shown on Plates B-4, B-5 and B-6. A tract (5.0 acres) of land located on the left bank of Reach PR-6 has been designated as mitigation lands and the location is shown on Plate B-6. The local sponsor, local officials, and adjacent property owners do not favor this plan as it involves destruction of backyard properties adjacent to the channel.

TABLE B-2

DESCRIPTION OF ALL CHANNEL PLAN - 35 YEAR PROTECTION - PLAN K
FAIRFIELD, OHIO

Degree of Protection	Reach	Stream Mile	Length in Miles	DESCRIPITION Bottom Width (Feet)	Depth (Feet)	Side Slopes and Type	Bridge Replacements
35-Year	Channel Enlargement only for Reaches PR-2 through PR-6						
	PR-2	0.60 - 0.96	0.36	110'	9.5	2H:1V/Riprap	
	PR-3	0.96 - 1.72	0.76	85 - 145	9.5	2H:1V/Riprap	
	PR-4	1.72 - 2.08	0.36	75 - 85	12	2H:1V/Riprap	East River Road
		2.08 - 2.19	0.11	65	12	VERT/Concrete	Pleasant Avenue
	PR-5	2.19 - 2.67	0.48	75 - 95	14.5	2H:1V/Riprap	
		2.67 - 2.69	0.02	115	14.5	VERT/Concrete	Nilles Road
	PR-6	2.69 - 3.52	0.83	120 - 195	9	2H:1V/Riprap	
	TOTAL		2.92				

Channel Right-of-Way = 69 Acres
Disposal Area = 60 Acres

Three Dry Bed Reservoir Plans - 35 and 100-Year Protection - Plans H and J

As shown on Plates B-3 and B-7 the 35-year protection plan provides for dry bed reservoirs at Sites A, C and D and 0.83 mile of channel enlargement in Reach PR-6. A detailed description of this plan is shown in Table B-3 and detailed costs are shown in Appendix E.

The location of dry bed reservoirs A, C and D are shown on Plates B-11, B-12 and B-13, respectively. Each dry bed reservoir consists of earth embankment on 3H:1V side slopes with an ogee spillway and a 48" conduit to allow normal water flow to pass through. Each dry bed reservoir requires land to be purchased for ponding areas and for borrow easements. The material excavated from the borrow area is used as embankment for the dry bed reservoir. The ponding area is acquired to allow for temporary ponding in the event of an intense rainfall. In all other times the ponding area will remain dry. For Site D, the majority of the area within the borrow area is utilized for temporary ponding storage.

No bridges are altered as a result of the 35-year plan and any disturbance to property owners in Reach PR-6 would be minimal.

Plates B-3, B-8, B-9 and B-10 show the 100-year protection plan. This plan provides for the same dry bed reservoirs A, C and D as for the 35-year plan but requires 1.37 miles of channel enlargement in Reaches PR-3, 4 and 6. A detailed description of this plan is also shown in Table B-3 and detailed costs are shown in Appendix E. As in the case of the 35-year plan, disposal areas are located in open area and mitigation lands are provided on the left bank of Reach PR-6.

Both the 35 and 100-year plans have included design features to reduce adverse environmental impacts and provide for recreation. The

TABLE B-3

DESCRIPTION OF THREE DRY BED RESERVOIR PLANS - PLANS H AND J
(Based on Future Conditions)

Degree of Protection	DESCRIPTION
100-Year (Plan J)	3-Dry Bed Reservoirs at Sites A, C and D plus a channel enlargement on Reaches PR-3, 4 and 6. Total length of channel enlargement = 1.37 miles. The dry bed reservoir sites are described as follows.

Site No.	Drainage Area in Square Miles	Spillway Crest Elevation	Top of Dam Elevation	Height of Dam	100-Yr Ponding Elevation	Dam R/W in Acres	Ponding Area in Acres	Borrow Area in Acres	Total Acres
A	1.0	662	673	37	658.2	11	10	10	31
C	3.2	671	688	47	665.9	21	20	23	64
D	2.8	701	713	44	695.5	14	27	4	45

The channel enlargement is as follows:

Reach	Stream Mile	Length in Miles	Bottom Width	Depth	Side Slopes and Type	Bridge Replacements
PR-3	0.94 to 1.34	0.40	35'	9.5'	.75H:1V/Gabions on left bank 2H:1V/Riprap on right bank	
PR-4	1.72 to 1.86	0.14	40'	12'	2H:1V/Riprap	
PR-6	2.69 to 2.91	0.22	50'	9'	1H:1V/Concrete	East River Road
	2.91 to 3.52	0.61	50'-60'	9'	2H:1V/Riprap	

Channel R/W = 21.5 Acres
Disposal Area = 12.4 Acres

TABLE B-3 (Continued)

Degree of Protection	DESCRIPTION
35-Year (Plan H)	The dry bed reservoirs are the same as for the 100-year plan. The channel enlargement only involves Reach PR-6 and is described as follows: Total length of channel enlargement = 0.83 miles.

Stream Mile	Bottom Width	Depth	Side Slopes and Type	Bridge Replacements
2.69 to 2.91	30' - 35'	9'	1H:1V+/Concrete	None
2.91 to 3.35	40' - 55'	9'	2H:1V/Riprap	--
3.35 to 3.52	55' - 60'	9'	2H:1V/Riprap	--

Channel R/W = 13 Acres
Disposal Area = 9 Acres

design features include widening of the channel on one side only when possible and constructing a low flow channel with pools and riffles (see typical section on Plate B-15). The borrow areas will be graded to drain and seeded and used for recreation areas.

Because of the high degree of protection provided by the 100-year plan the local sponsor and local officials have indicated their desire for this plan.

Three Dry Bed Reservoirs Plus Nonstructural Measures - Plan I

This alternative involves the construction of dry bed reservoirs at sites A, C and D plus flood proofing, evacuation of structures from the flood plain, and relocation of flood prone structures out of the flood plain to provide for a 100-year degree of protection.

The dry bed resevoirs are the same as for the three dry bed reservoir plus channel enlargement plan and the description of the nonstructural measures have previously been discussed.

The dry bed reservoirs, when used by themselves, provide for an approximate 35-year degree of protection for the reaches downstream. In order to provide for protection for a 100-year flood it is necessary to apply nonstructural measures to the remaining 340 units within the 100-year flood plain not protected by the dry bed reservoirs. Of these 340 units, 291 can be flood proofed, 35 units must be evacuated, and 14 units can be relocated. Detailed costs for this plan are shown in Appendix E.

As this plan was the least damaging to the environment, it was selected as the EQ plan. The acquisition of about 52 acres of ponding area and 42 acres of land for borrow, when combined with recreation, will preserve the areas of the dry bed resevoirs which are threatened by urban surroundings and provide positive environment quality impacts.

While this plan is the least damaging to the environment, local officials and property owners in the flood plain have voiced their opposition to nonstructural measures particularly in view of the residual adverse effects to emergency vehicle access and health and sanitary conditions.

IMPACT ASSESSMENT AND EVALUATION OF DETAILED PLANS

The four plans warranting detailed consideration have been identified and described. A discussion of the impacts associated with these plans is provided below. The information is furnished in respect to natural, cultural and social resources. Impact assessment and evaluation for economic factors are presented in Appendix E.

Natural Resources - Channel Enlargement Plan

Soils, Erosion and Streambank Effects

The channel enlargement alternative for alleviating flooding along Pleasant Run will have both adverse and beneficial effects concerning soils, erosion, and the streambanks. Adverse impacts will include short term erosion due to exposure and disturbance of soil from construction and clearing activities. This erosion will result in sediment accumulation in the stream and will continue until natural vegetation is reestablished and soils are stabilized. However, reduced flooding will reduce erosion and scouring of the flood plain. Upon completion of the project. graded side slopes of the new channel will be upgraded to minimize future erosion and reduce sediment accumulations.

Air Quality

Implementation of the channel enlargement alternative will increase the suspended particulate level as fugitive dust from construction and wind erosion of disturbed soil. The condition will persist as a short term effect only during construction; it will have no long term impact on air quality. There will be minor emissions of gaseous pollutants (hydrocarbons, carbon monoxide, nitrogen dioxide, and sulfur dioxide) from construction related vehicle operation. Again, these emissions will be generated only for a short time.

Noise Levels

Short term increases in noise levels in the study area from channel enlargement construction activities will occur. This will cause temporary inconvenience to local residents.

Water Quality

Channel enlargement construction will cause short term and long term changes in water quality. These changes will occur from increased suspended sediment, increased water velocity, and effects upon the substrate. Increased turbidity as a short term impact will result from higher levels of suspended and dissolved solids within the stream. This is caused by soil disruption during construction and subsequent erosion. Impacts from the increased sediment load to Pleasant Run may extend into the Miami River for a distance downstream of the confluence point. Increased stream velocities are not expected to have any significant effect upon the Miami River since it is a much larger stream. Removal of shade trees as a result of the project would cause a long term increase in water temperature. Removal of riffles from the stream bed would cause a decrease in the dissolved oxygen concentration

and corresponding pollutant assimilative capacity. Long term impacts would be reduced by construction of pools and riffles.

Vegetation

A significant adverse impact from the channel enlargement plan would occur from clearing of vegetation. This will involve removal of riparian trees and associated plant communities. Upon construction completion, streambanks will be riprapped and seeded. Selective planting in this area will produce changes in the existing environment by reducing species diversity. Construction of the channel enlargement alternative will produce spoil material which will require disposal or utilization. Disposal of this material in the designated areas, which cover about 60 acres, will bury some existing plant communities which are composed primarily of either cropland or grass. Other effects will involve the disruption of vegetated areas from relocation of utilities (e.g., water mains and sanitary sewerlines).

Wildlife

Channel widening with attendant vegetation clearing would cause loss of terrestrial wildlife. During construction, noise, dust, etc., will stress most wildlife. Mobile species such as birds and large mammals may leave the immediate area; however, they may be subjected to competition from other animals in the adjacent habitats. After construction, it is anticipated that this condition will reach equilibrium. Disturbed areas will be seeded which will alter species diversity. Disposal of generated spoil material will result in habitat burial and some wildlife displacement. Yet, if properly vegetated to curb runoff sediment and airborne dust problems, this material should provide new habitat for some small animal species. An additional adverse effect will result from water main and sanitary sewerline

relocations out of the construction area. This will affect vegetative communities and wildlife habitats on a short term basis.

Aquatic Biota

Alteration of channel for the channel enlargement will adversely affect aquatic life within Pleasant Run. Both flora and fauna will be disturbed by alteration of the present water course. However, riffles and pools will be reconstructed as practicable. If construction takes place in the spring, migration of certain species of fish could be disrupted. Benthic organisms and some aquatic flora will be affected by siltation. Removal of shade trees from along the stream will cause elevation of water temperature. Decreased dissolved oxygen concentration resulting from elimination of streambed characteristics (riffles, etc.) will reduce the creeks pollutant assimilative capacity. But under plans to recreate those conditions, this will not be a long term effect.

Threatened or Endangered Species

The channel enlargement plan would have no impact since threatened or endangered species are not known to exist in the area.

Natural Resources - Three Dry Bed Reservoirs With Channel Enlargement Plans

The channel enlargement portion of these plans would have impacts similar to those discussed for the channel enlargement plan. Therefore, discussion of these plans will concentrate on impacts of the dry bed reservoirs.

Soils, Erosion and Streambank Effects

Construction for dry bed reservoir alternatives will cause short term increases in erosion and siltation through borrow excavation, fill placement, and channel widening. Disturbed areas will be reseeded upon construction completion.

Air Quality

Construction of the reservoir alternatives would cause increased levels of suspended particulates and minor emissions of gaseous pollutants on a short term basis.

Water Quality

Short term erosion resulting from dam construction will increase the suspended sediment load of the stream. However, in time, the revegated soil will stabilize and this effect will diminish. The dams will cause the retention of small amounts of sediment. The net effects of the dams is not expected to involve any significant long term impact upon water quality of Pleasant Run.

Vegetation

For the three dry bed reservoirs, vegetation clearing will be required in connection with the channel improvement portion, borrow excavation, and dam fill placement. The three borrow areas cover a total of about 42 acres and are composed mainly of grassy fields. Acquisition of the right-of-way for the dams, which would cover 46 acres, would necessitate the removal of about 20 acres of woods. The remaining land is mostly old fields. The reservoir alternatives would have the benefit of excluding land within the ponding areas from future development and thereby preventing future vegetation clearing in these

areas. Temporary impoundment of runoff by the dams would result in occasional inundation of vegetation. Filling and draining of the reservoirs would occur in less than 24 hours, so only plant species which are very intolerant of flooding would be affected. The overall impact on vegetation from occasional inundation would be slight.

Wildlife

Dam construction and associated borrow excavation will eliminate wildlife habitat. Animals will be displaced into adjacent habitat which may not be able to support the increased competition. Selective planting of grass, shrubbery, etc., in disturbed areas will provide new habitat with less diversity. Preservation of the land within the ponding areas will protect wildlife habitat from encroachment by urban development. Impoundment of flood waters may cause loss of less mobile animal species which are unable to flee rising water levels.

Aquatic Biota

Dam construction will have short term effects upon aquatic biota through increases in siltation. Dam fill placement will eliminate sections of stream habitat. The dams will have uncontrolled outlet structures which will pose no barriers to fish migration. Periodic impoundment and changes in the streamflow regime should not have significant effects upon the quality of aquatic habitat. The channel enlargement portion of the dry bed reservoirs alternatives would have impacts as described above.

Threatened or Endangered Species

The considered plans would have no impact since threatened or endangered species are not known to exist in the area.

Natural Resources - Three Dry Bed Reservoirs With Nonstructural Measures Plan

The impacts of the reservoirs' aspects of this plan have been previously discussed. The nonstructural measures proposed for this plan would not have significant impact upon natural resources.

Cultural Resources

Butler County is one of the richest Ohio counties in terms of prehistoric archeological sites, particularly in the number of mounds. In Fairfield Township, previously recorded archaeological sites include 17 mounds, seven enclosures, and one prehistoric cemetery. Of these sites four mounds and one enclosure have been recorded for the Pleasant Run flood plain. The enclosure site is located on the Pleasant Run streambank in the vicinity of Groh Lane. Due to excavation of these sites and intensive development in the area, the majority of the sites have been destroyed.

An onsite walking reconnaissance of the considered construction area was undertaken in-house by a qualified archaeologist in October 1980. Inspection of exposed creek banks, small erosional cuts, and occasional parcels of cultivated land immediately adjacent to the creek revealed no prehistoric or early historic remains. No additional archaeological investigations are recommended for this area.

Butler County, lying in the Great Miami River Valley, has been under settlement since the 18th Century. Fertile soils and flat to gently rolling land made this area a major agricultural region in the early 19th Century. To provide improved transportation to agricultural markets, the Miami and Erie Canel was built, which led to a manufacturing boom. The Great Miami Valley is still one of the more important industrial areas of the United States.

Investigation for historical sites in the Pleasant Run Basin provided negative results. The National Register of Historic Places has no listings in Fairfield Township. Neither the Ohio Historical Society nor the Butler County Historical Society recognize any historical sites in the study area. A possible site of historical interest is the Symmes Cemetery located just downstream of Banker Road.

No significant archaeological or historical sites remain in the area to be affected by the proposed alternatives.

Social Resources

Relocation

None of the considered structural plans would require relocation of existing structures except the plan for Site A. The structure to be relocated is a 12-unit apartment building. No residential, institutional or business activities are planned for relocation in the subject areas.

Transportation

The channel enlargement plan would result in disruption of traffic on Nilles Road, which is a major local, traffic artery and some residential streets, but the disruption would be limited to the period of construction. In the long run this plan would result in reduction of traffic disruption on routes currently subject to flooding and the road repair and traffic diversion costs connected therewith. Construction activities of plans for Sites A, C and D would most likely intervene intermittently in traffic flows of the immediate areas without causing significant traffic disruptions.

Employment and Income

Since the "with" and "without" conditions are estimated to be approximately the same, the only major improvement of employment and income would be that connected with project construction and loss of production due to flooding.

Land Use

The open space in plans for Sites A, C and D would improve value of existing and planned property within the surrounding residential corridors. Further, all the considered plans would alleviate the image of Fairfield as "flood prone" which tends to discourage industrial activities from location in the city. The subject open space would also prevent an image of "congestion" which would be almost inevitable otherwise.

In general the considered plans would not hinder or disrupt long term land use activities in the study area. However, in the short runs, property owners within the flood prone areas would be inconvenienced temporarily by construction activities of the channel improvement plan because houses are located very close to the channel.

The dry bed reservoirs would require acquisition of 31 acres in Site A, 64 acres in Site C and 45 acres in Site D. Without the project, portions of this acreage would be developed for a mix of urban uses, mostly residential.

The channel enlargement plan would require right-of-way acquisition and acquisition of acreage for disposal of material excavated from the channel.

All considered plans are compatible with the Southwest Ohio Water Development Plan, OKI Regional Transportation and Development Plan, Miami River Corridor Plan, and OKI open space plan.

PLAN SELECTION

Plan selection is the designation of the alternative plan considered to be the most desirable. The plan should best meet the needs and desires of the public while adequately addressing the planning objectives, constraints, and criteria. Although a large number of factors are considered in selecting the best plan, Table B-4 shows the major considerations and the impacts of each flood control plan.

Based on the tabulations and results of studies accomplished for this report and public views obtained, Plan J, the three dry bed reservoir plan with 1.37 miles of channel widening in Reaches PR-3, 4, and 6 providing 100-year protection appears to best meet all selection factors. This plan provides the maximum degree of protection possible without extensive disruption of downstream property owners and insures that future upstream runoff caused by new subdivisions will be regulated thus providing for equitable protection. The channel enlargement work will cause some adverse environmental impacts, while the construction of the three dry bed reservoirs will insure open areas that may be used for fish and wildlife and recreation. This plan is also acceptable to the local sponsor and the City of Fairfield, and has net beneficial contributions. Although the net benefits are not as high as Plan H, the minor additional impacts of Plan J upon the existing properties and stream are offset by the provision of a substantial higher degree of protection.

The extent of the plan was based on economic and equitable protection concepts. Although the Reach PR-6 damage area contains about 30 percent of the damages, a plan to only protect this area would have induced damages in other areas. Also, recent development in the upstream drainage basin could cause increased flood levels unless a method was found to intercept these flows. For these reasons, a series of three dry bed reservoirs was chosen along with limited channel

TABLE B-4

CONSIDERATIONS AND IMPACTS OF EACH FLOOD CONTROL PLAN

Factors	35-Year All Channel Plan Plan K	Three Dry Bed Reservoir Plan 35-Year Plan H	Three Dry Bed Reservoir Plan 100-Year Plan J	Nonstructural Plan Plan I
Views of Local Sponsor	Undesirable	Prefers 35-year plan	Preferable	Undesirable
Net Benefits	$23,000	$430,000	$304,000	$41,000
Environmental Impact	Adverse	Positive	Positive	Positive
Equity of Protection	Fair	Good	Good	Good
Remaining Conditions	AAD of $190,000 or or 18 percent of damages remain; extensive backyard property is destroyed	AAD of $37,000 or 3 percent remain; flooding becomes rare	AAD of $31,000 or 3 percent remain; flooding becomes rare	AAD of $16,000 or 1.5 percent remain; flooding is essentially eliminated

widening in Reaches PR-3, 4, and 6 to insure that all downstream areas would be protected at present and in the future.

The detailed design for the selected plan is shown in Table B-3. A typical section for a dry bed reservoir is shown on Plate B-16. The ponding area for Site A (Plate B-11) is located within a heavily wooded area and the infrequent and short duration of flooding (1 day for a 100-year flood) will have little impact upon this area. The borrow area for Site A is located outside this wooded area in an open field. The removal of approximately 15 feet of material and the contouring/grading of this borrow area will also have little impact upon the environmental surroundings. The borrow area necessary for Site C (Plate B-12) is larger than for Site A because of the additional material needed to construct the dry bed reservoir. Neither the temporary ponding land nor the borrow area is located in a wooded area. The borrow area will have approximately 8 feet of material removed and then graded and seeded to best fit the surrounding contours. Neither the borrow area for Site A nor Site C will be inundated due to temporary ponding, thus making it possible to have permanent recreation facilities. At Site D, the borrow area is rather limited. A location was selected above the wooded area so that when material was removed the location could be used as storage for temporary ponding. Approximately 12 feet of material will have to be excavated and graded to contain the ponding.

The utilities involved with these sites include relocation of sanitary sewers and an 8-inch pipeline owned by SOHIO.

Environmental compensation measures to reduce any adverse impacts include the low flow channel (Plate B-15) in Reaches PR-3, 4, and 6, approximately nine artificial pools and riffles in Reach PR-6, widening of the 0.83 mile of channel in Reach PR-6 on one side when possible, the preservation of the borrow areas at the dry bed reservoir sites and the wooded area in the temporary ponding area at Site A and the planting of trees and shrubs. These measures, along with 5 acres of land acquired

AD-A111 738 ARMY ENGINEER DISTRICT LOUISVILLE KY F/G 13/2
WATER RESOURCES DEVELOPMENT MIAMI RIVER, LITTLE MIAMI RIVER, AN--ETC(U)
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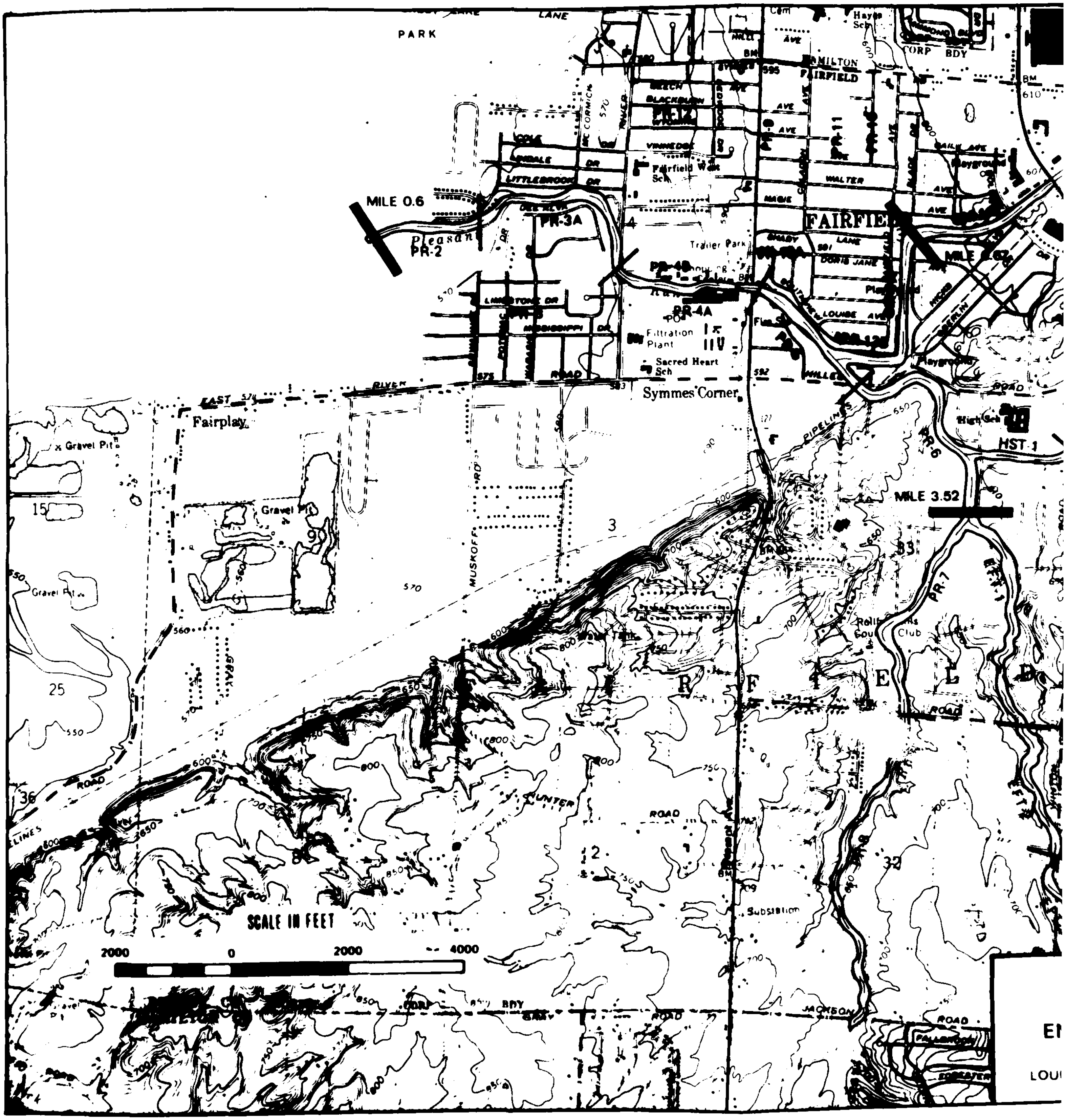
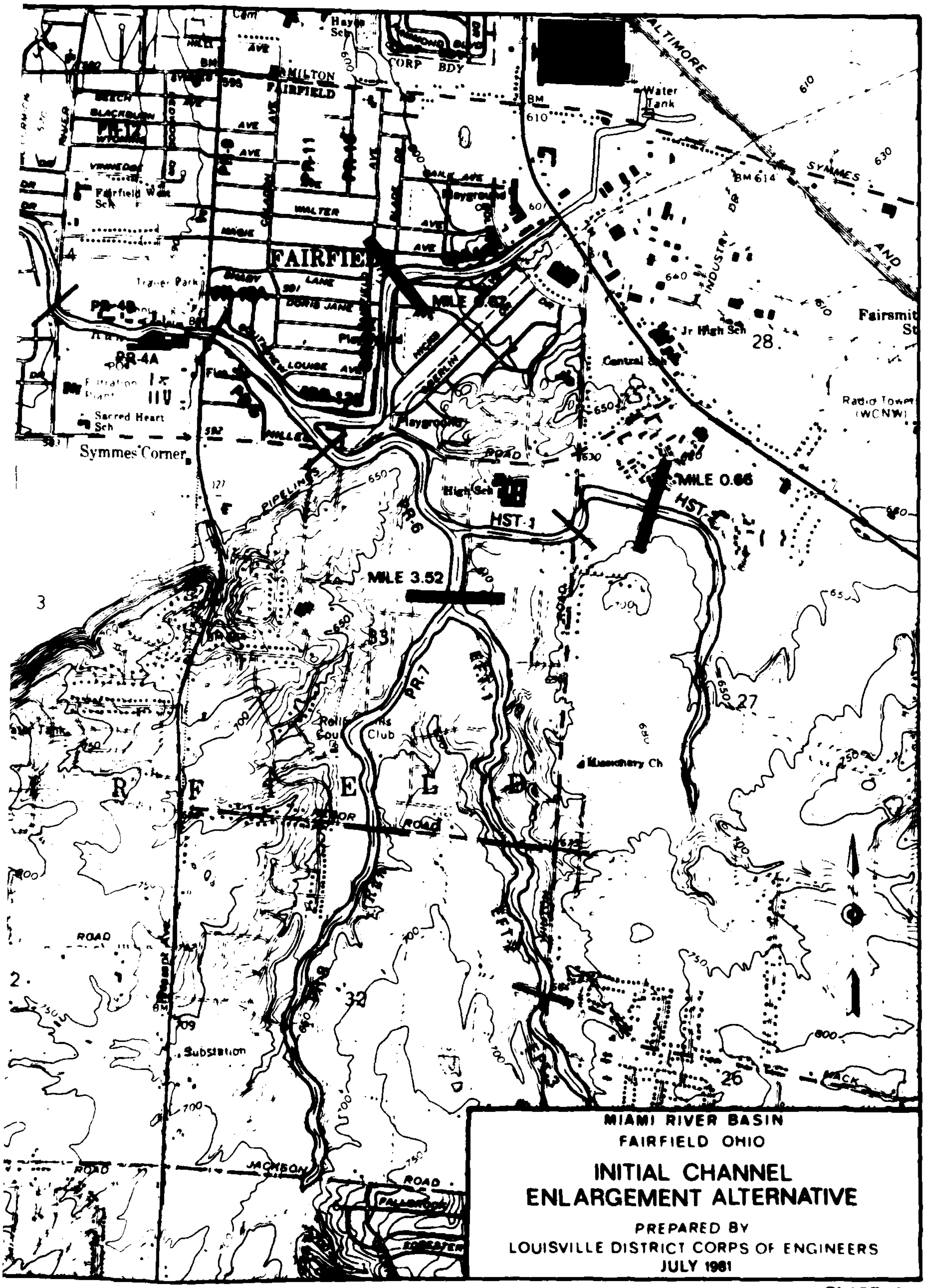
2 of 6

on the left bank of Reach PR-6 (see Plate B-10), will reduce the impacts on the existing fish and wildlife resources and aesthetics of the area.

Local officials overwhelmingly chose the three dry bed reservoirs plan over the all channel plan (see Exhibit C-1 in Appendix C) and stated that utilizing the dry bed reservoir sites for recreational purposes would also provide benefits for the citizens. To provide day use type activities of walking, jogging, bicycling, outdoor games, and picnicking, recreational facilities consisting of trails, picnic units, and play equipment were added to the selected plan. The facilities as envisioned now will include the three dry bed reservoir sites and will be located either in the borrow areas or temporary ponding areas. These facilities are to be used as community parks with parking facilities. Detailed descriptions of the recreation facilities are contained in Appendix F and Table E-6.

APPENDIX B
PLATES


PARK
LANE
MILE 0.6
Pleasant
PR-2
PR-3A
PR-12
PR-11
PR-4A
FAIRFIE
Fairfield West Sch
Trailer Park
Filtration Plant
Sacred Heart Sch
Symmes Corner
MILE 2.62
Fairplay
Gravel Pit
MILE 3.52
HST-1
High Sch
PR-6
PR-7
Rolling Greens Club
Substation
SCALE IN FEET
2000
0
2000
4000
HAMILTON
FAIRFIELD
CORP BDY
EAST RIVER ROAD
MUSKOFF RD
GUNTER ROAD
JACKSON ROAD
Playground
Hayes Sch
WALTER
LOUISE AVE
LITTLEBROOK DR
LIMESTONE DR
MISSISSIPPI DR
EN
LOU



MIAMI RIVER BASIN
FAIRFIELD OHIO

INITIAL CHANNEL ENLARGEMENT ALTERNATIVE

PREPARED BY
LOUISVILLE DISTRICT CORPS OF ENGINEERS
JULY 1981

PLATE B-1

2

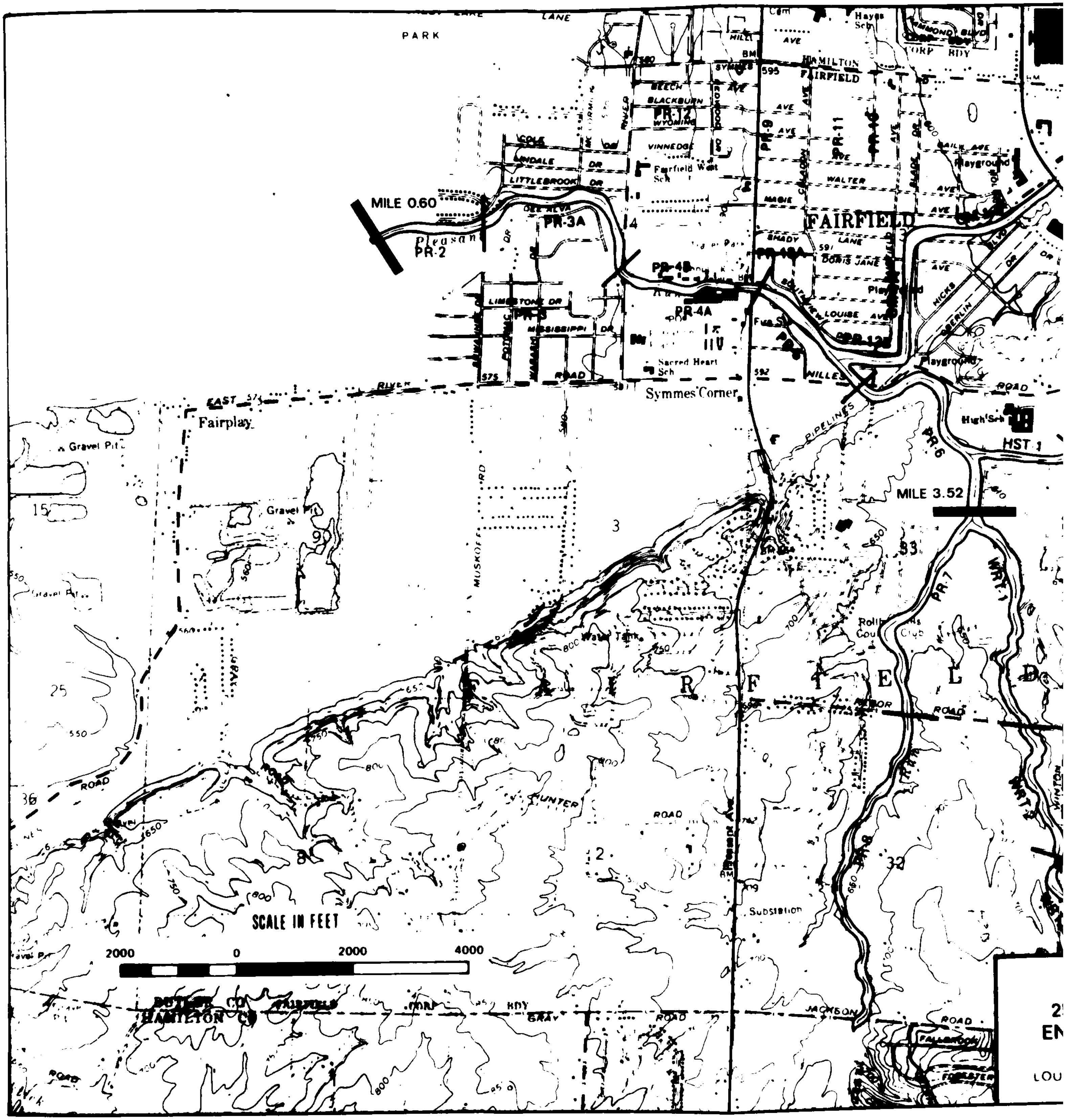
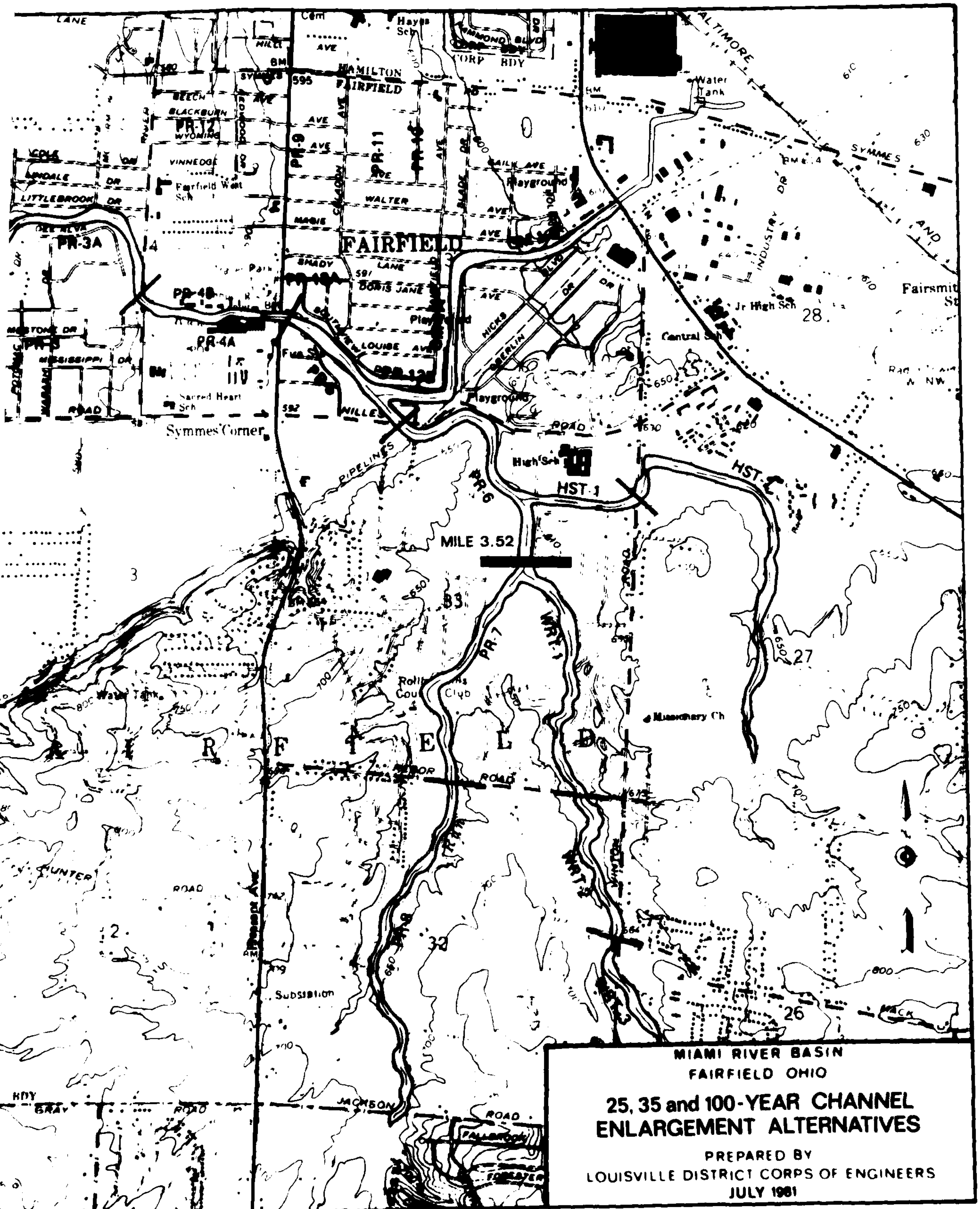

PARK
LANE
HAMILTON
FAIRFIELD
CORP BDY
MILE 0.60
PR-2
PR-3A
PR-4A
PR-4B
PR-12
PR-9
PR-11
FAIRFIELD
Fairfield West Sch
Sacred Heart Sch
Symmes Corner
Fairplay
Gravel Pit
EAST RIVER ROAD
PIPELINES
Playground
High Sch
HST-1
MILE 3.52
PR-6
PR-7
PR-8
WRT-1
Water Tank
HUNTER ROAD
Substation
JACKSON ROAD
SCALE IN FEET
2000
0
2000
4000
BUTLER CO
HAMILTON CO
FAIRFIELD CORP BDY
GRAY ROAD

PLATE B-2



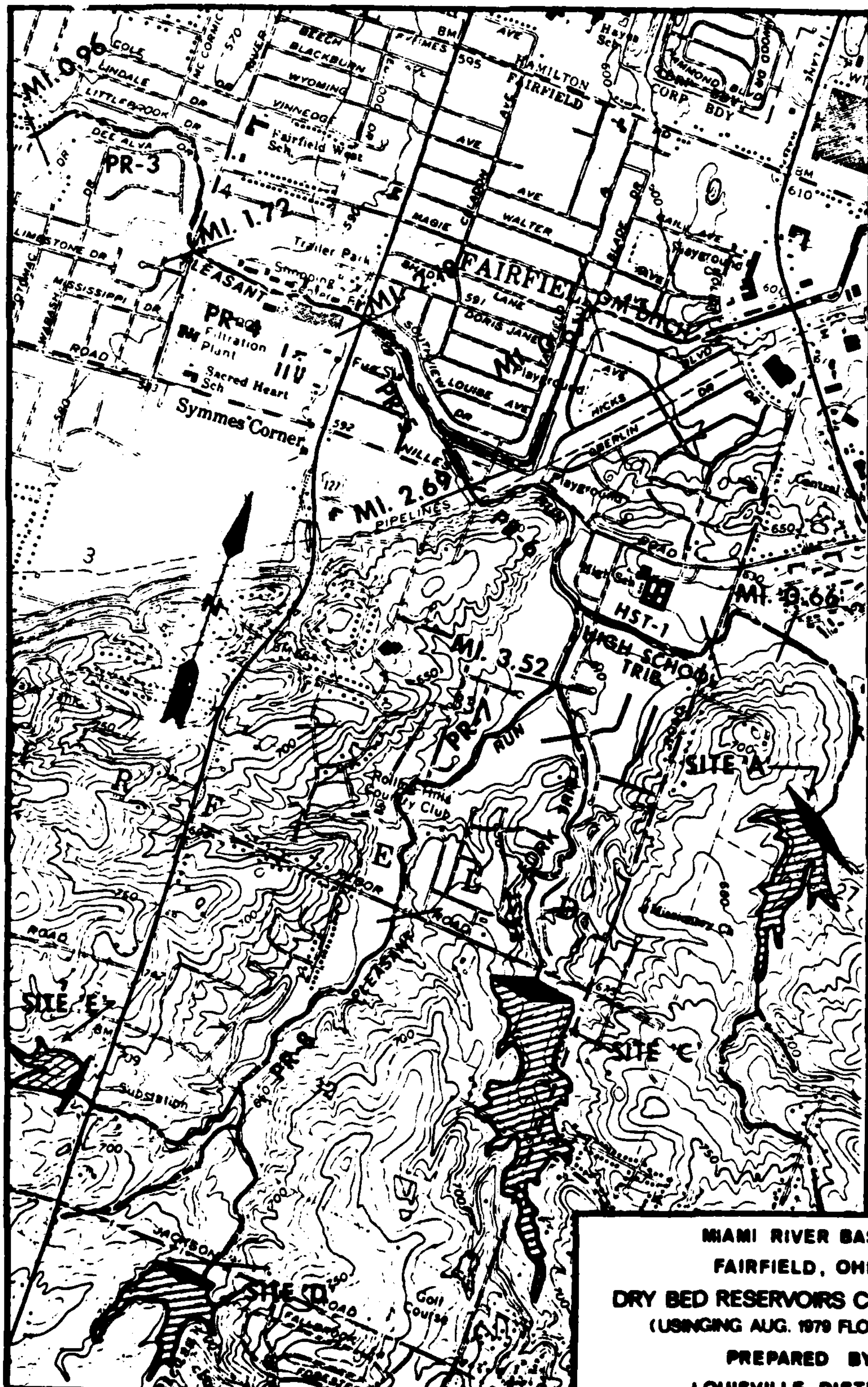
MIAMI RIVER BASIN
FAIRFIELD OHIO

25, 35 and 100-YEAR CHANNEL ENLARGEMENT ALTERNATIVES

PREPARED BY
LOUISVILLE DISTRICT CORPS OF ENGINEERS
JULY 1981

PLATE B-2

2



MIAMI RIVER BASIN

FAIRFIELD, OHIO

DRY BED RESERVOIRS CONSIDERED

(USINGING AUG. 1979 FLOOD DATA)

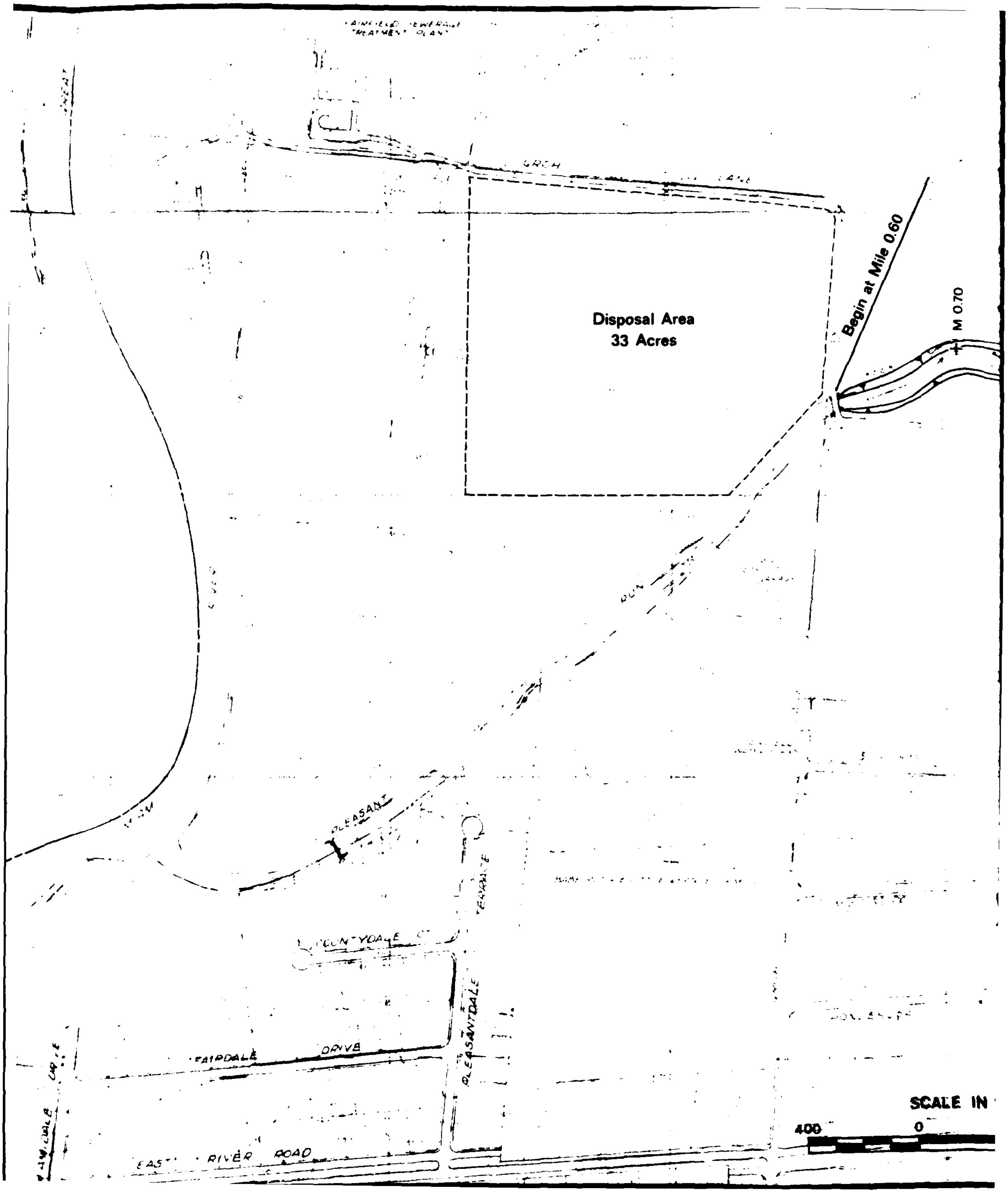
PREPARED BY

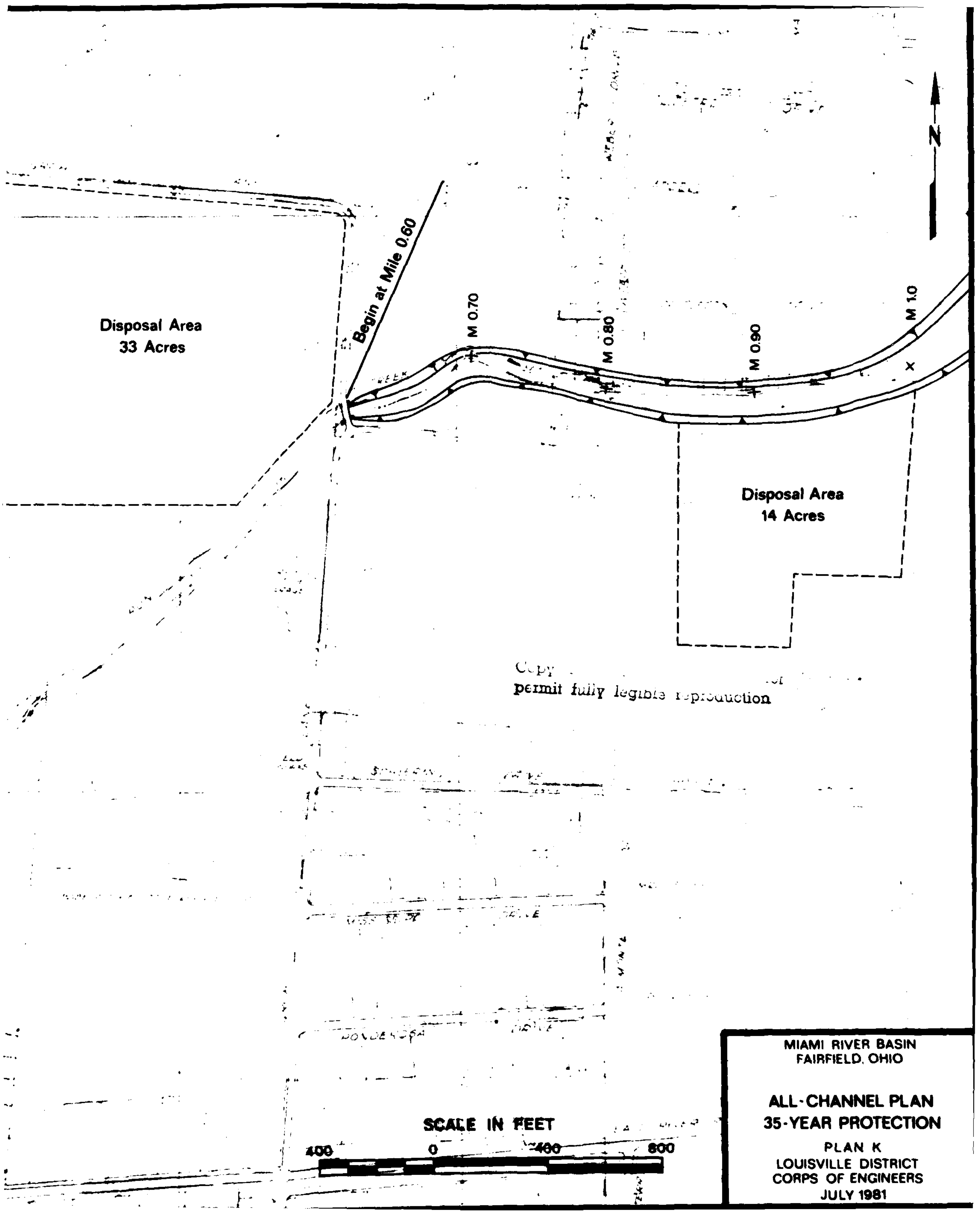
LOUISVILLE DISTRICT

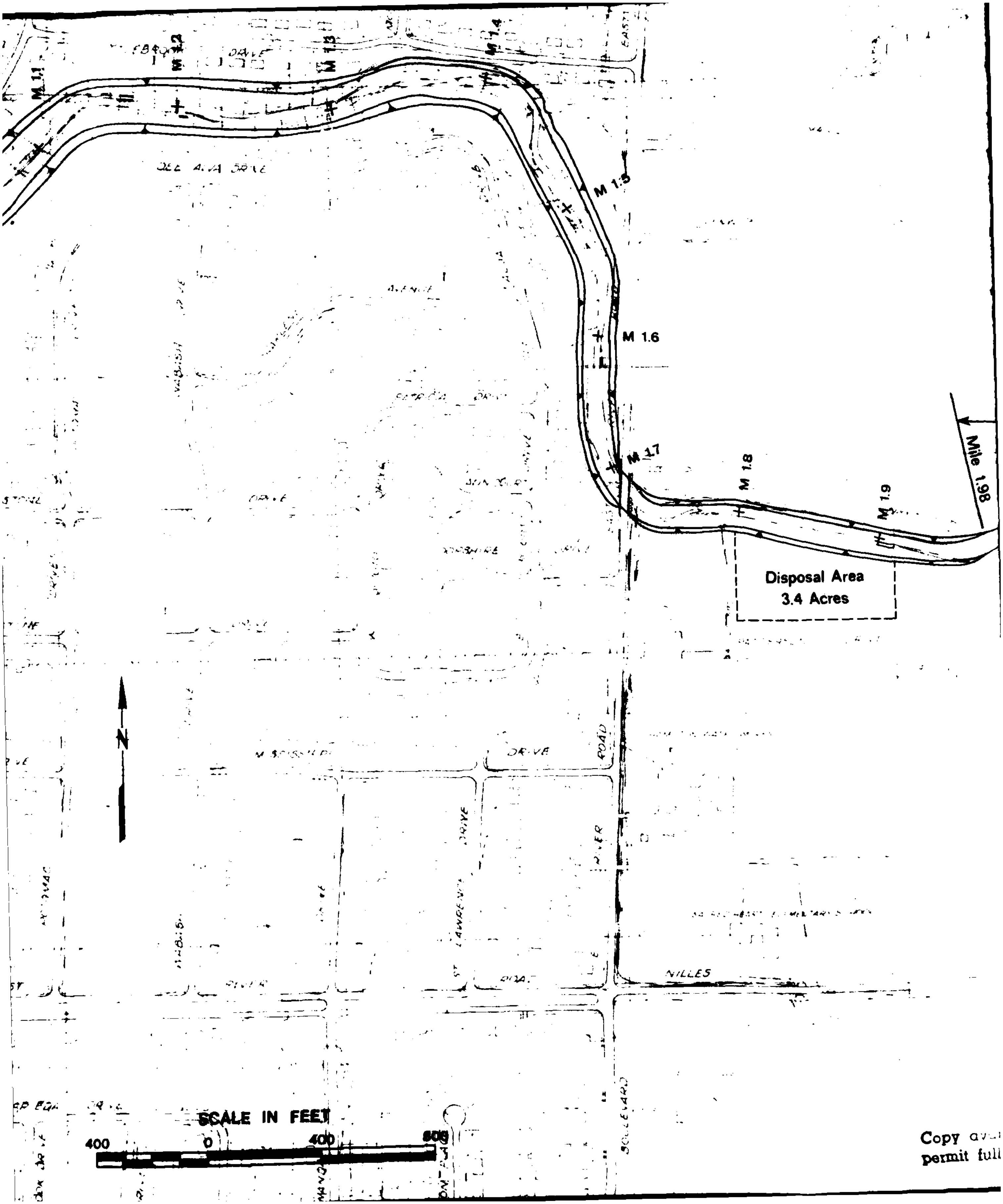
CORPS OF ENGINEERS

JULY 1981

PLATE B-3


Disposal Area
33 Acres
Begin at Mile 0.60
M 0.70
PLEASANT
TERRACE
PLEASANTDALE
FAIRDALE
DRIVE
EAST
RIVER
ROAD
SCALE IN
400
0


Disposal Area
33 Acres
Begin at Mile 0.60
M 0.70
M 0.80
M 0.90
M 1.0
N
Disposal Area
14 Acres
SCALE IN FEET
400
0
400
800
MIAMI RIVER BASIN
FAIRFIELD, OHIO
ALL-CHANNEL PLAN
35-YEAR PROTECTION
PLAN K
LOUISVILLE DISTRICT
CORPS OF ENGINEERS
JULY 1981



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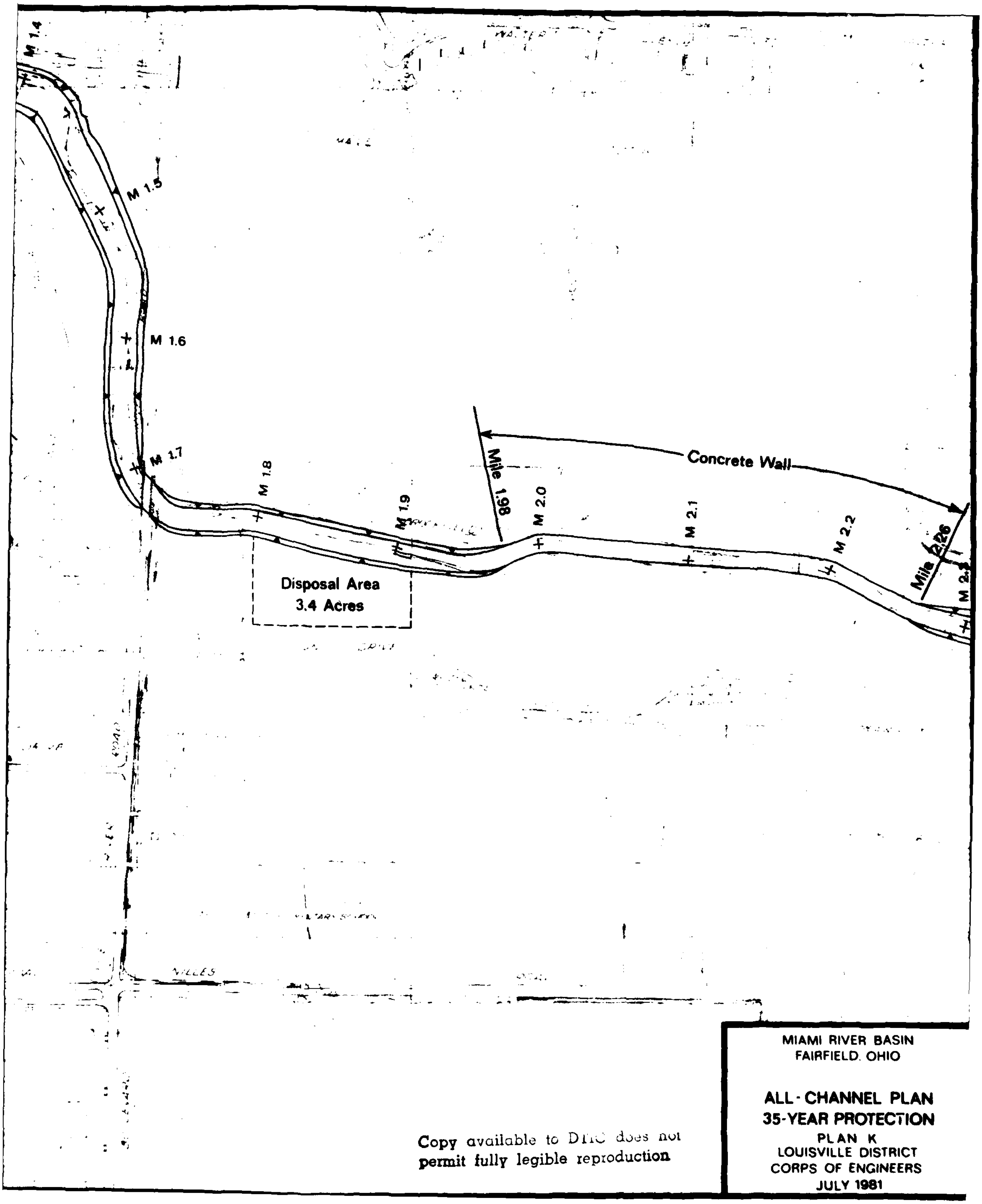
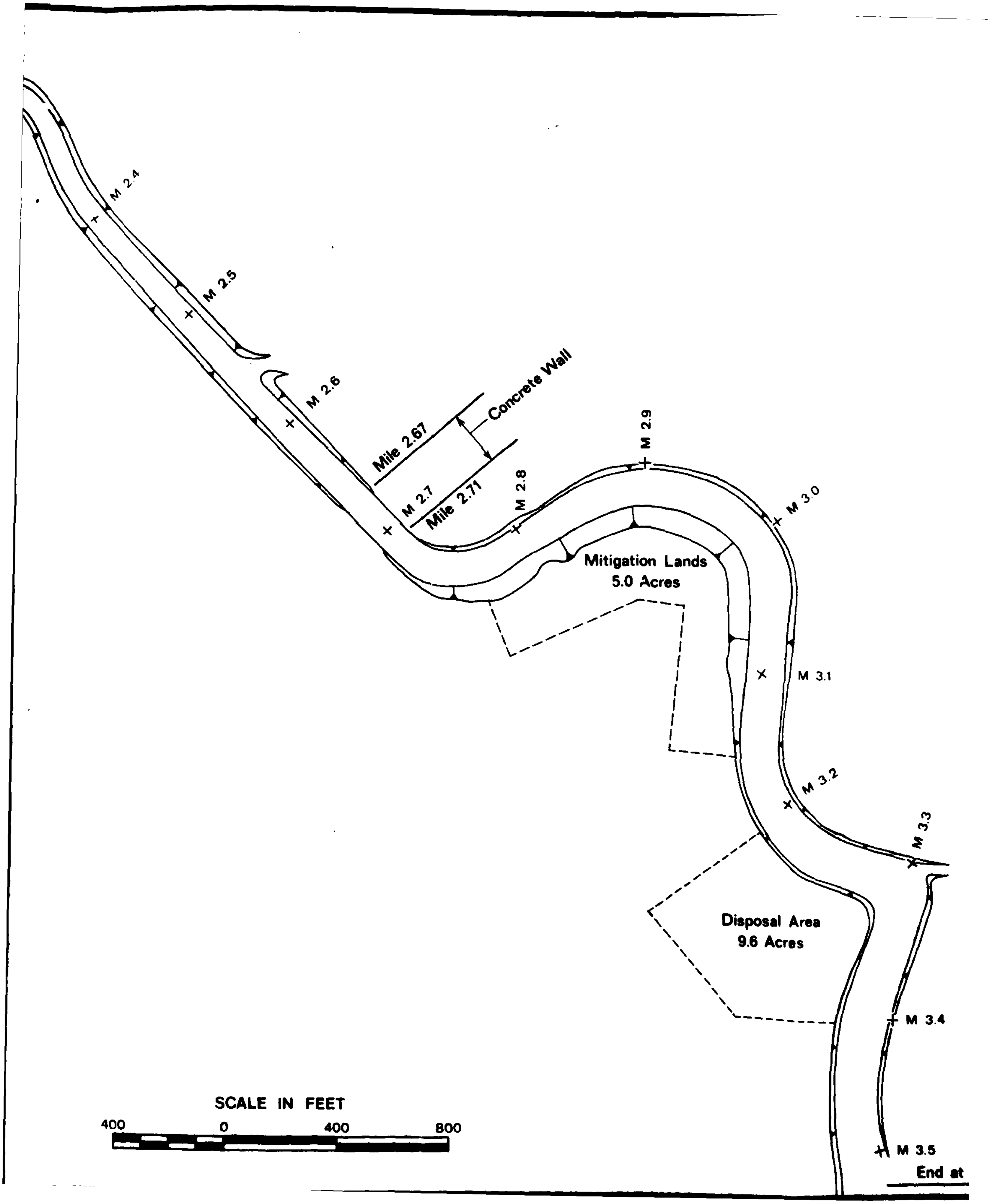


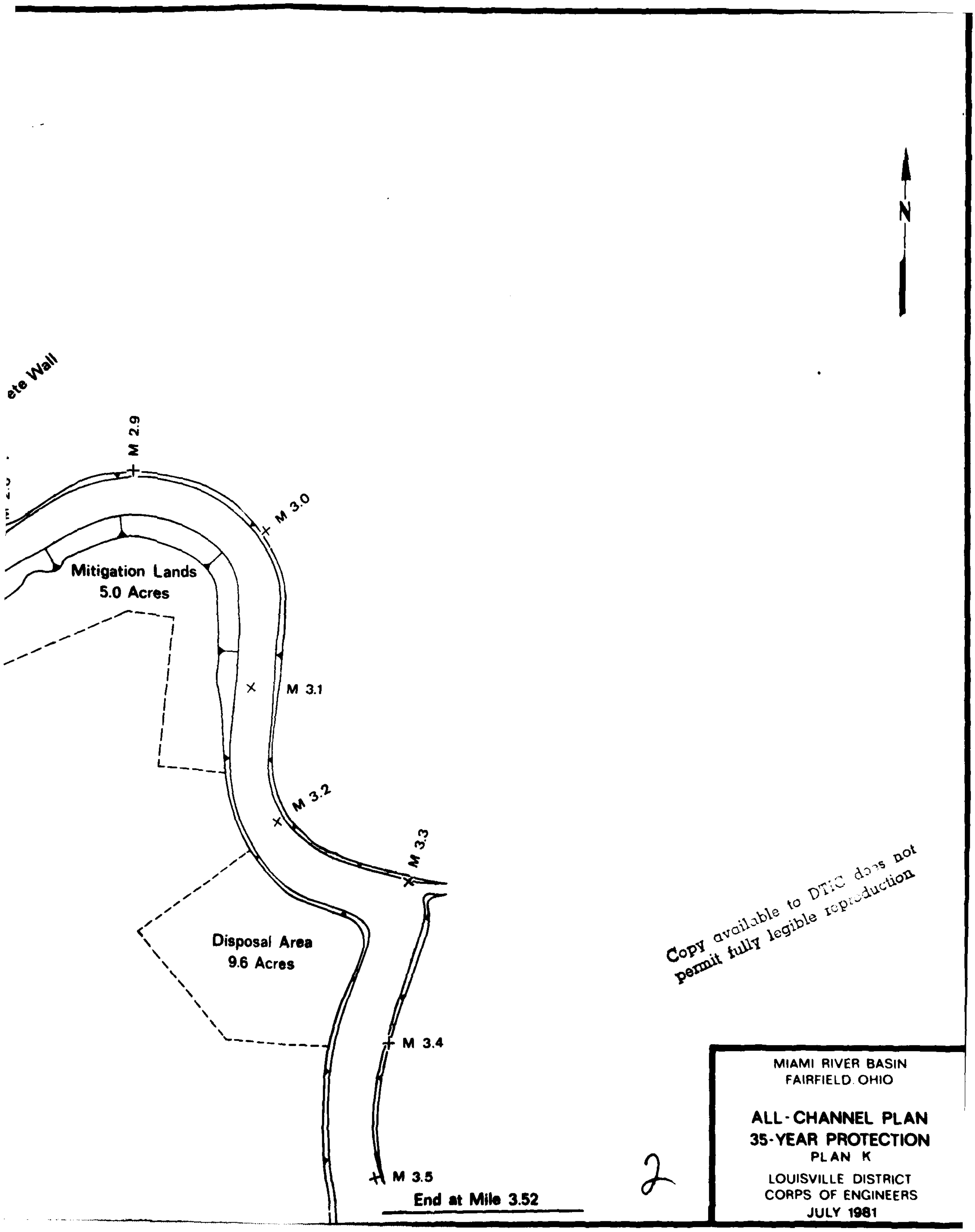
MIAMI RIVER BASIN
FAIRFIELD, OHIO

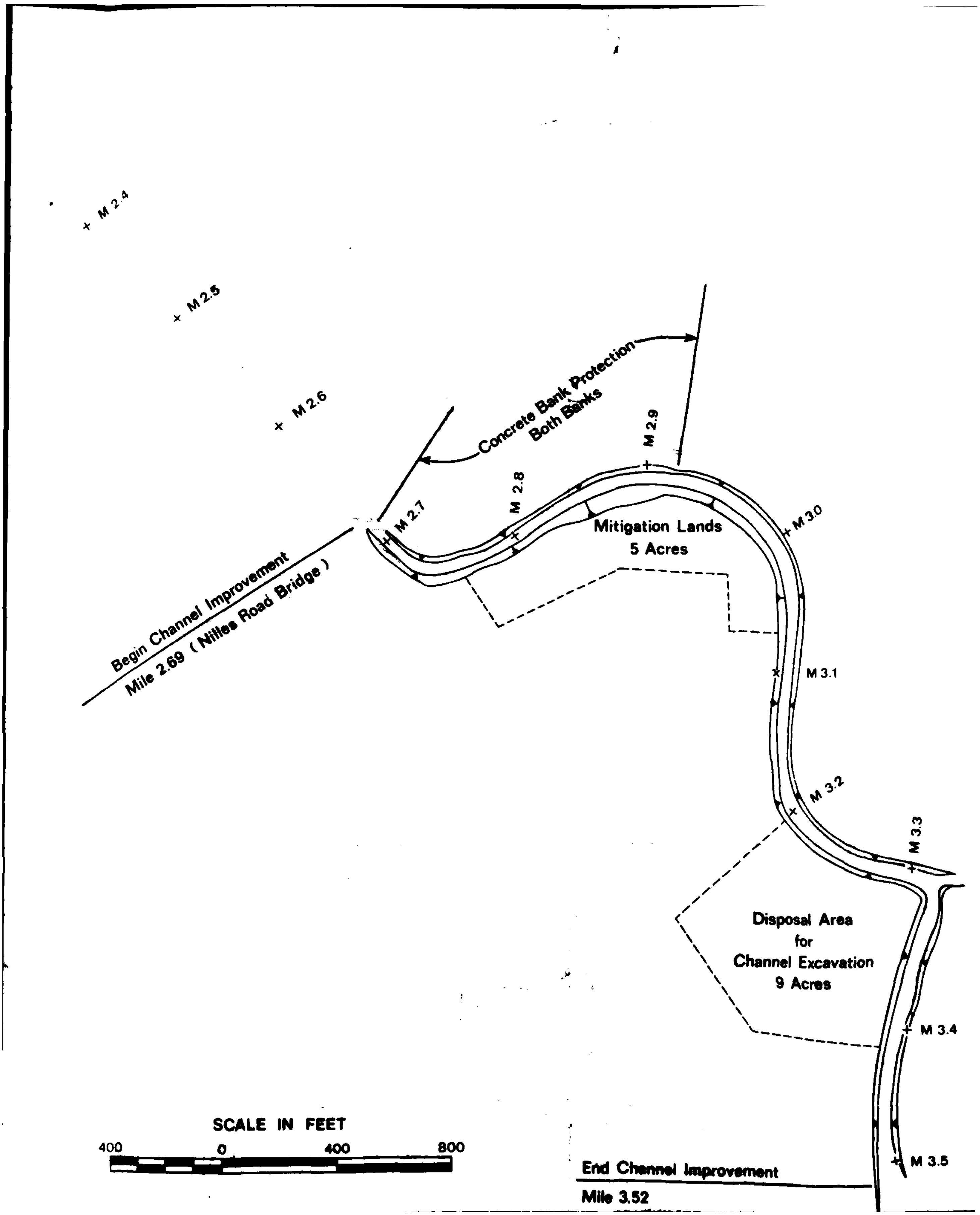
ALL - CHANNEL PLAN
35-YEAR PROTECTION

PLAN K
LOUISVILLE DISTRICT
CORPS OF ENGINEERS
JULY 1981

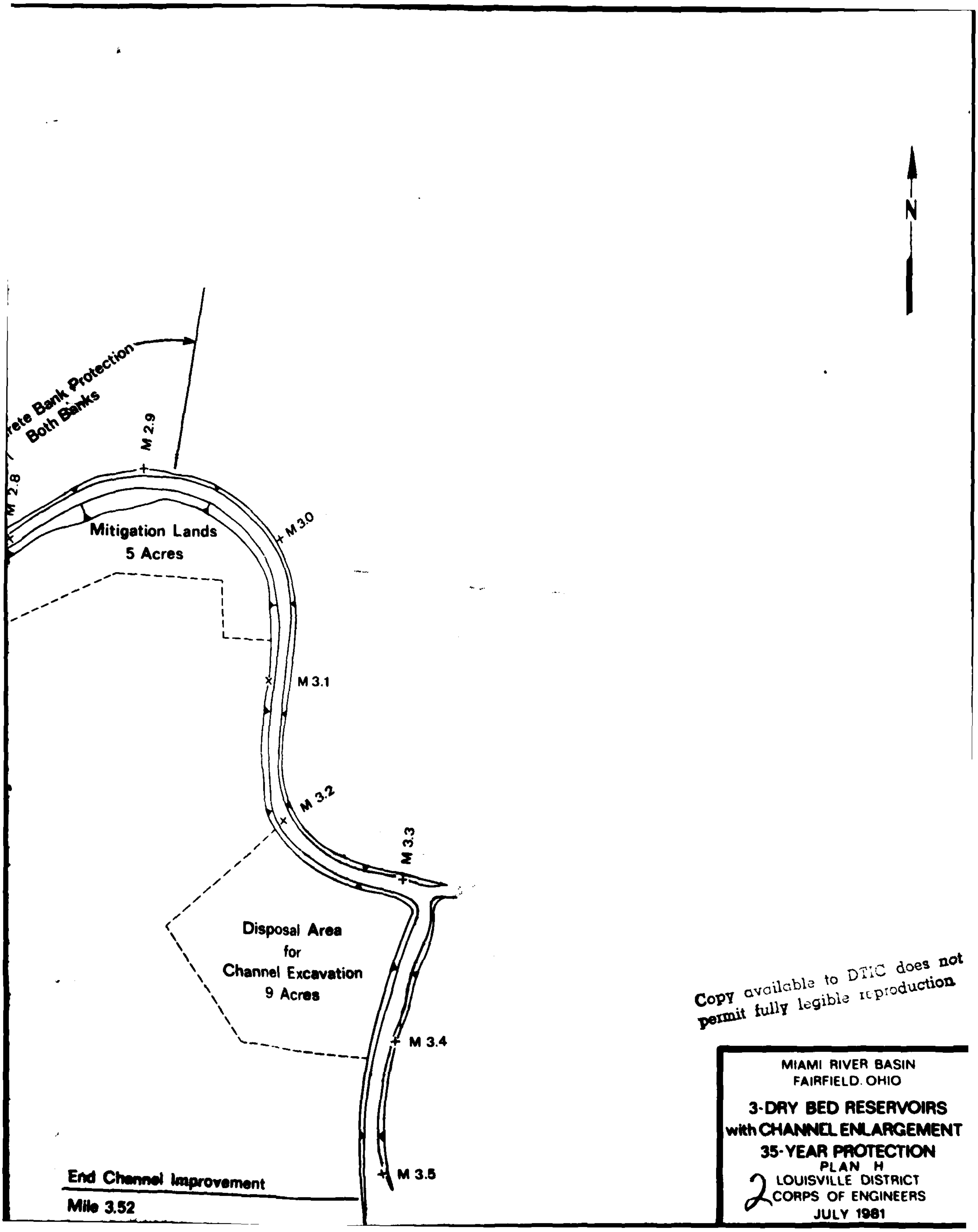


M 2.4
M 2.5
M 2.6
Concrete Wall
Mile 2.67
Mile 2.71
M 2.7
M 2.8
M 2.9
M 3.0
Mitigation Lands
5.0 Acres
M 3.1
M 3.2
M 3.3
Disposal Area
9.6 Acres
M 3.4
M 3.5
End at
SCALE IN FEET
400
0
400
800


ete Wall
M 2.9
M 3.0
Mitigation Lands
5.0 Acres
M 3.1
M 3.2
M 3.3
Disposal Area
9.6 Acres
M 3.4
M 3.5
End at Mile 3.52
N
2
MIAMI RIVER BASIN
FAIRFIELD, OHIO
ALL-CHANNEL PLAN
35-YEAR PROTECTION
PLAN K
LOUISVILLE DISTRICT
CORPS OF ENGINEERS
JULY 1981



M 2.4
M 2.5
M 2.6
M 2.7
M 2.8
M 2.9
M 3.0
M 3.1
M 3.2
M 3.3
M 3.4
M 3.5
Concrete Bank Protection
Both Banks
Mitigation Lands
5 Acres
Begin Channel Improvement
Mile 2.69 (Nilles Road Bridge)
Disposal Area
for
Channel Excavation
9 Acres
SCALE IN FEET
400
0
400
800
End Channel Improvement
Mile 3.52


N
rete Bank Protection
Both Banks
M 2.8
M 2.9
M 3.0
Mitigation Lands
5 Acres
M 3.1
M 3.2
M 3.3
Disposal Area
for
Channel Excavation
9 Acres
M 3.4
M 3.5
End Channel Improvement
Mile 3.52
MIAMI RIVER BASIN
FAIRFIELD, OHIO
3-DRY BED RESERVOIRS
with CHANNEL ENLARGEMENT
35-YEAR PROTECTION
PLAN H
LOUISVILLE DISTRICT
CORPS OF ENGINEERS
JULY 1981
2

CORPS OF ENGINEERS

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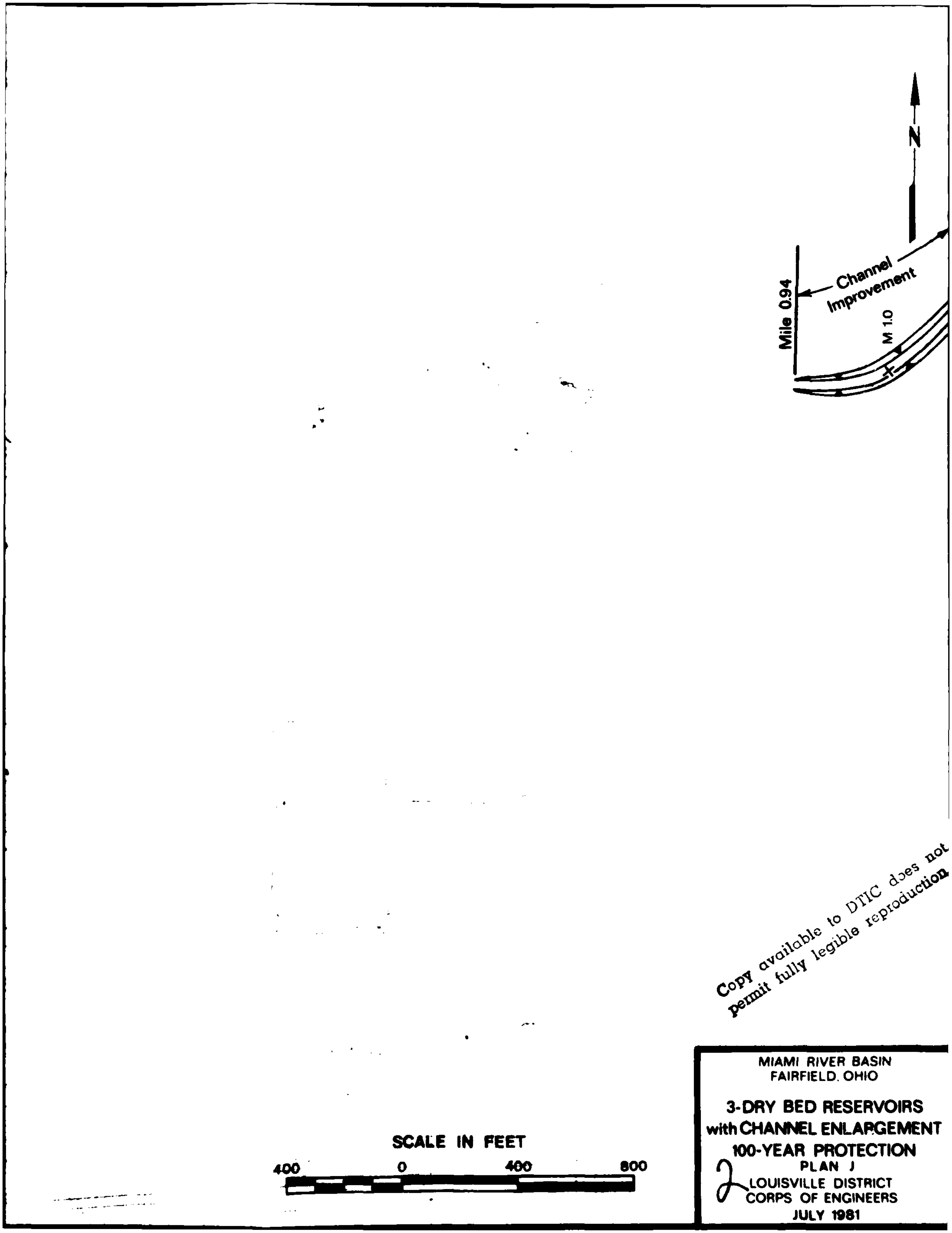
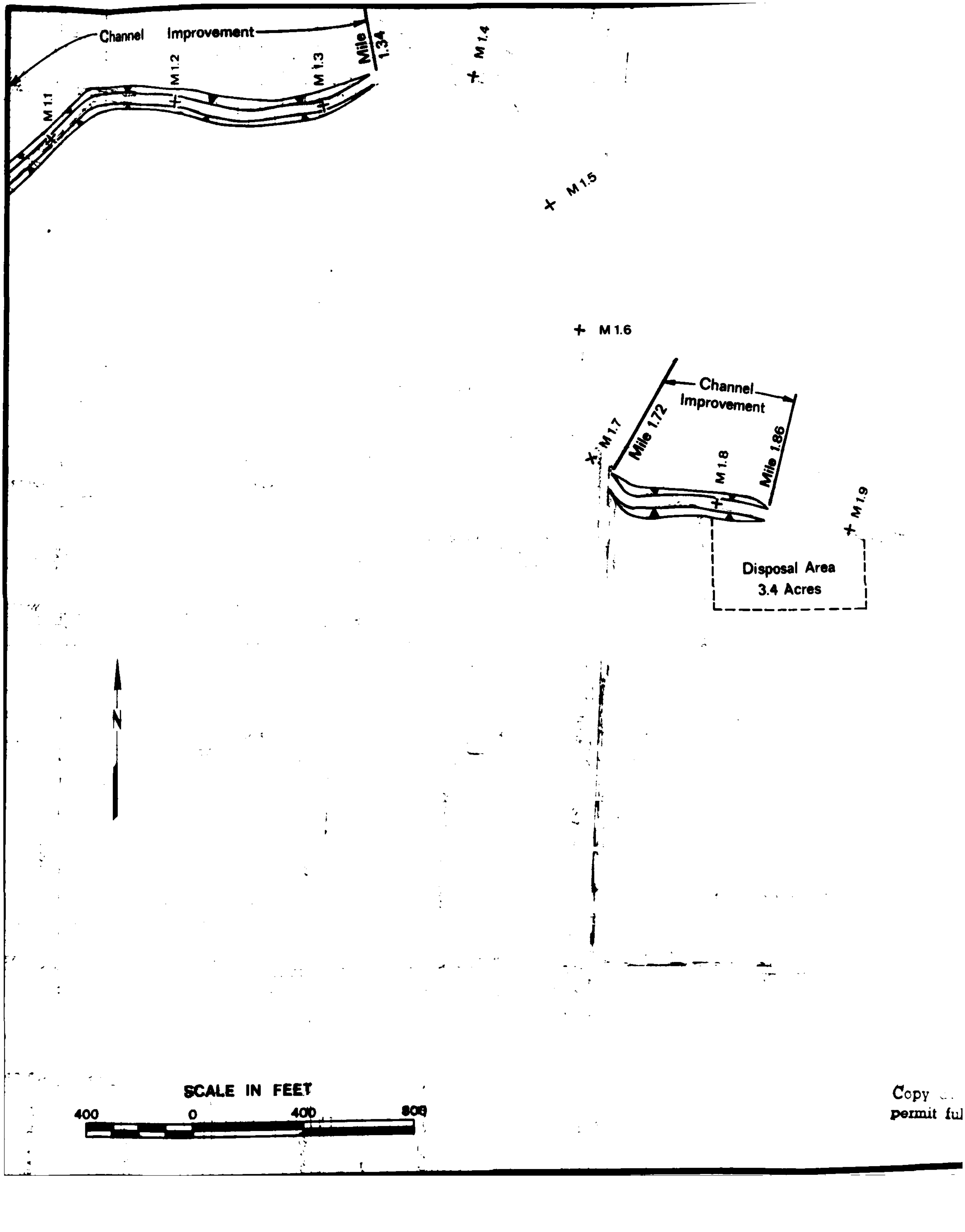


MIAMI RIVER BASIN
FAIRFIELD, OHIO

3-DRY BED RESERVOIRS
with CHANNEL ENLARGEMENT
100-YEAR PROTECTION
PLAN J

LOUISVILLE DISTRICT
CORPS OF ENGINEERS
JULY 1981



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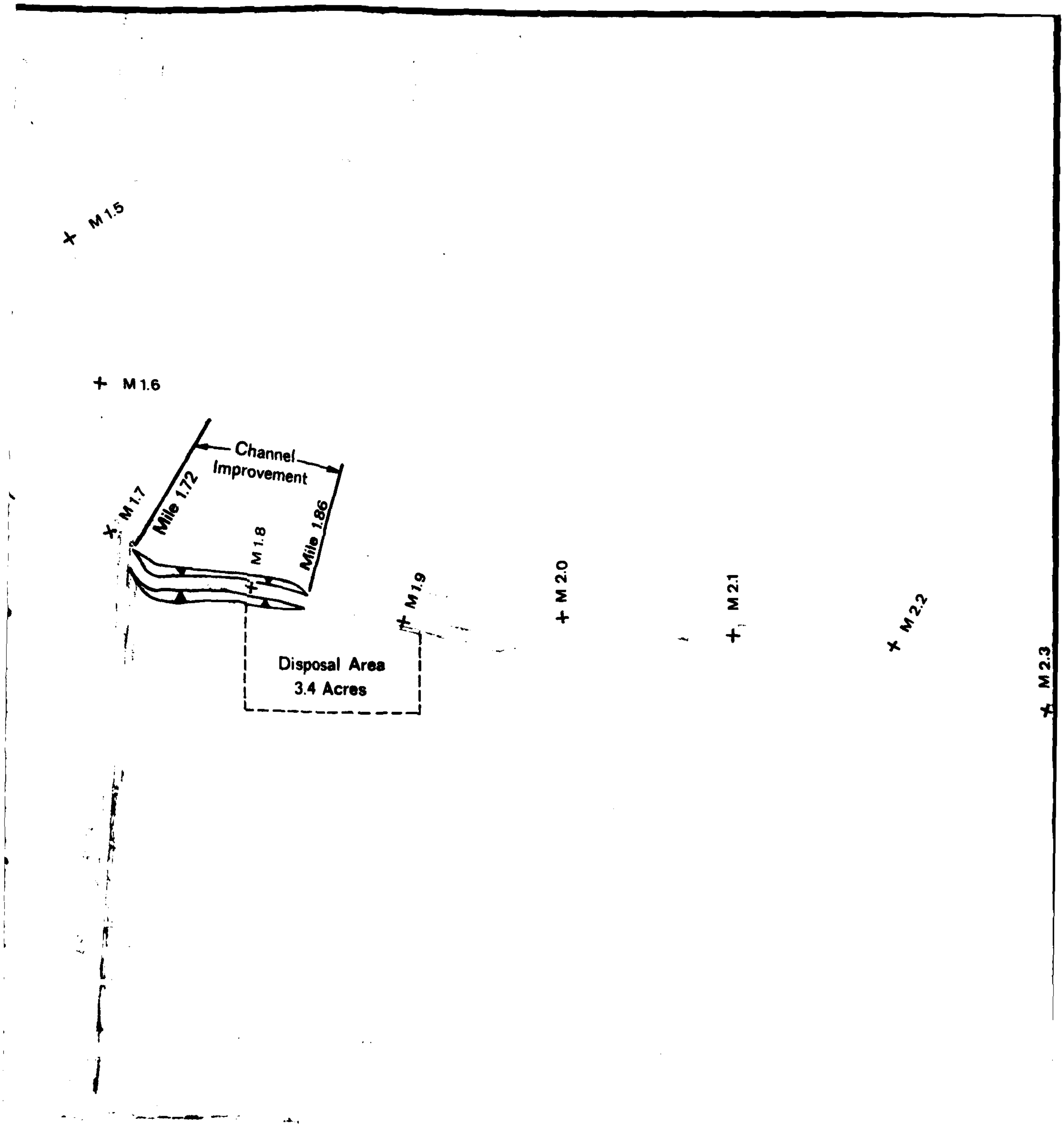
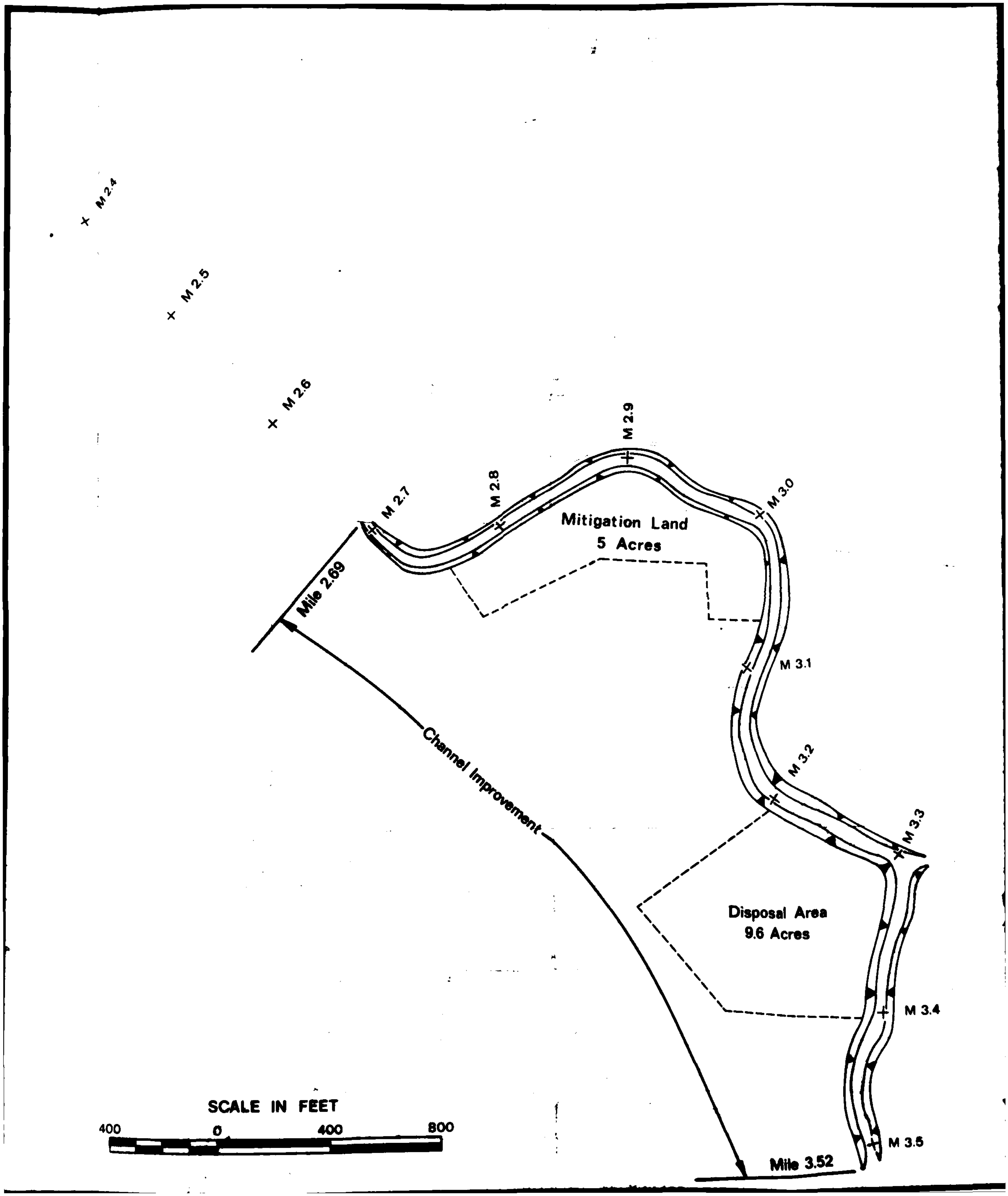
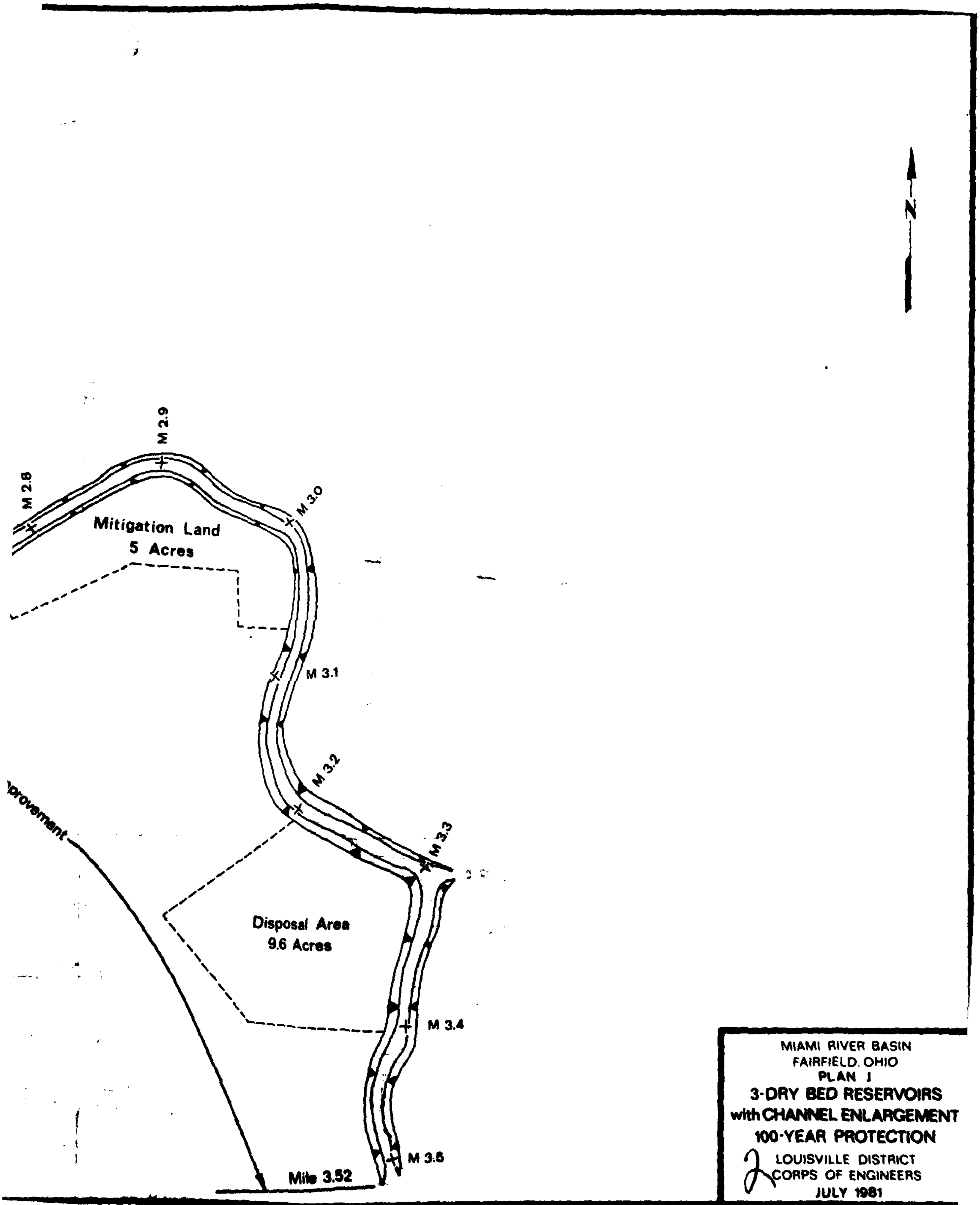


MIAMI RIVER BASIN
FAIRFIELD, OHIO

3-DRY BED RESERVOIRS
with CHANNEL ENLARGEMENT
100-YEAR PROTECTION
PLAN J

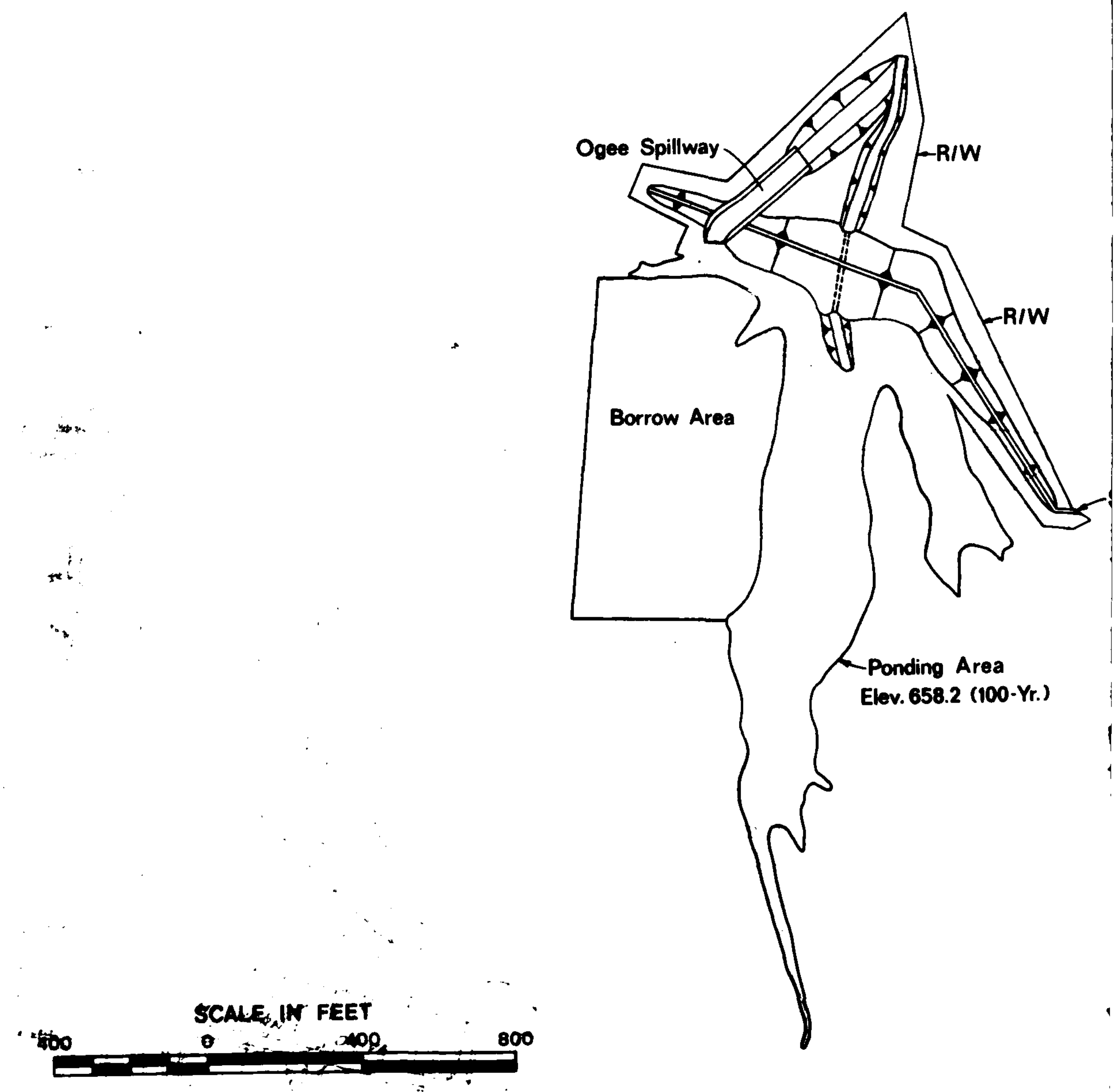
LOUISVILLE DISTRICT
CORPS OF ENGINEERS
JULY 1981

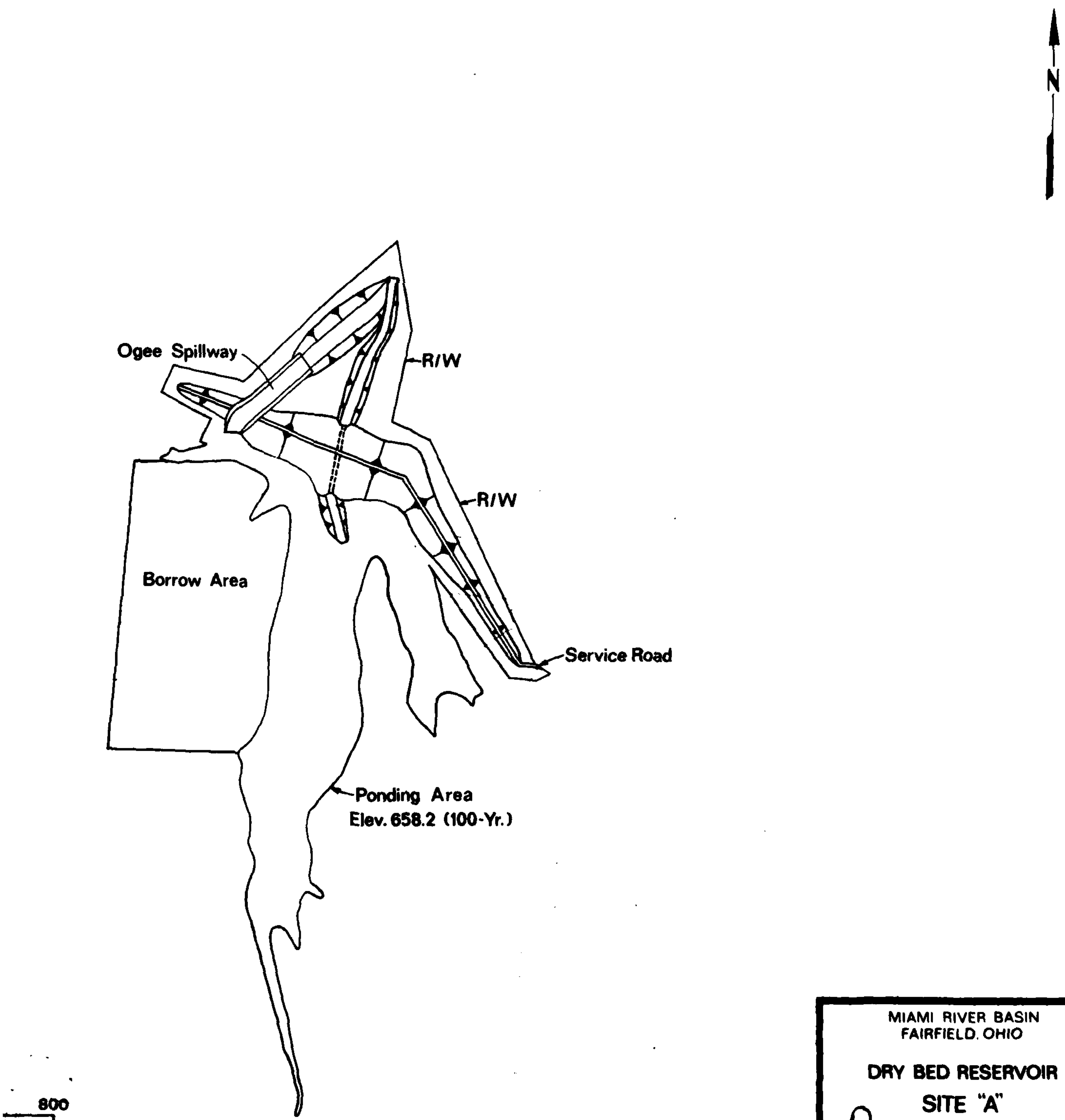

M 2.4
M 2.5
M 2.6
M 2.7
M 2.8
M 2.9
M 3.0
Mitigation Land
5 Acres
Mile 2.69
M 3.1
M 3.2
Channel Improvement
M 3.3
Disposal Area
9.6 Acres
M 3.4
SCALE IN FEET
400
0
400
800
M 3.5
Mile 3.52



MIAMI RIVER BASIN
FAIRFIELD, OHIO
PLAN 1
3-DRY BED RESERVOIRS
with CHANNEL ENLARGEMENT
100-YEAR PROTECTION
LOUISVILLE DISTRICT
CORPS OF ENGINEERS
JULY 1981

PLATE B-


Ogee Spillway
R/W
R/W
Borrow Area
Ponding Area
Elev. 658.2 (100-Yr.)
SCALE IN FEET
400
0
400
800

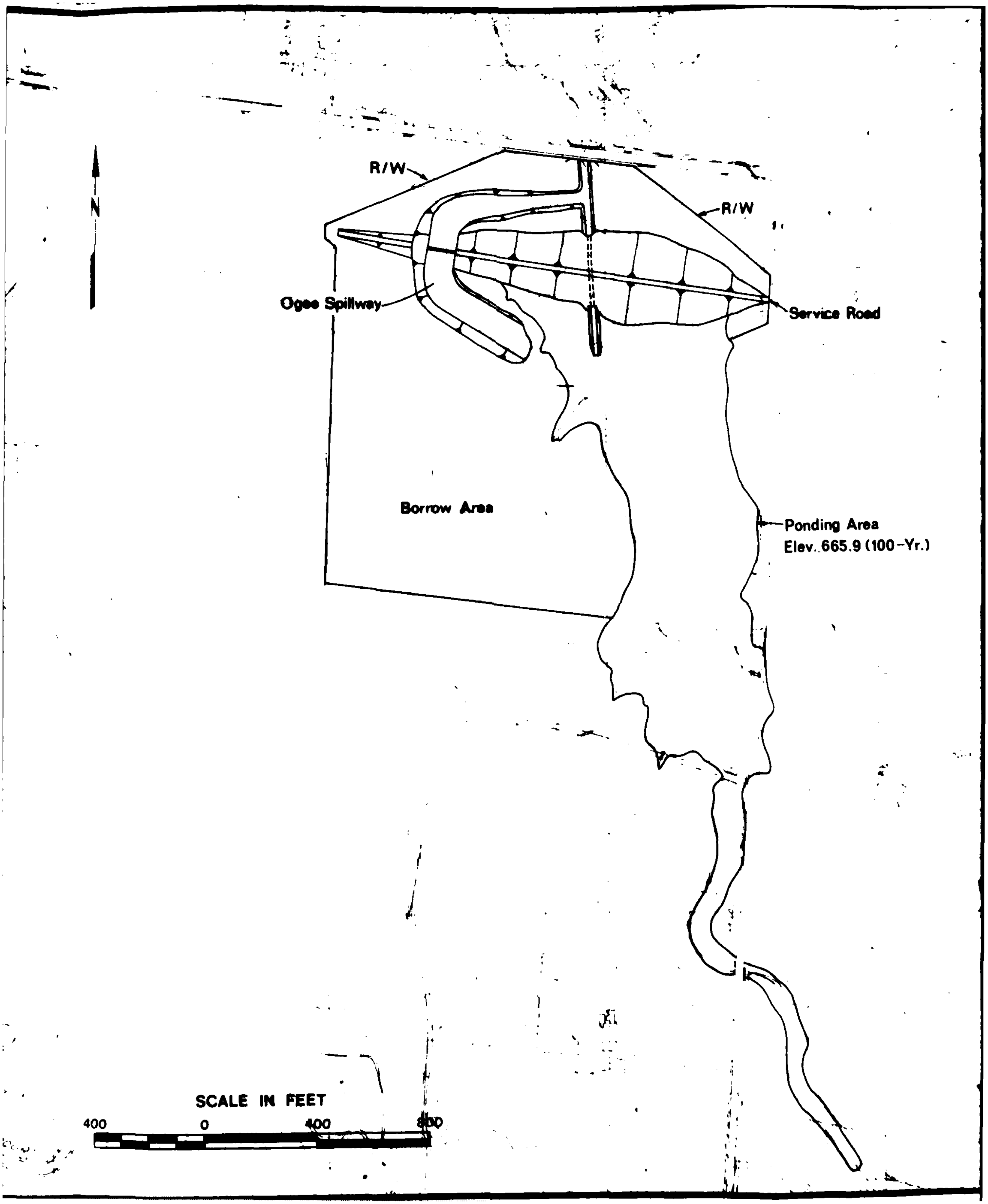


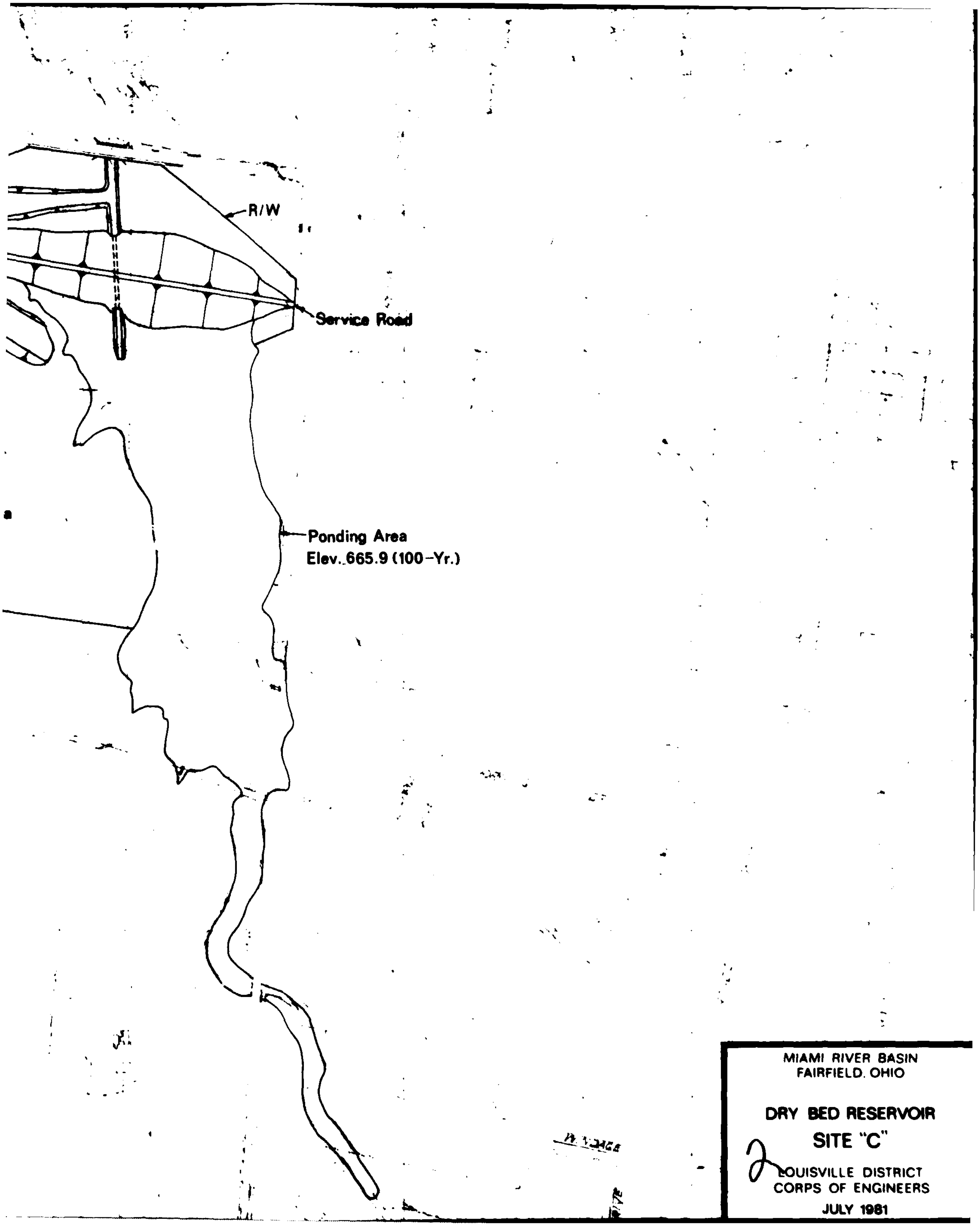
MIAMI RIVER BASIN
FAIRFIELD, OHIO

DRY BED RESERVOIR

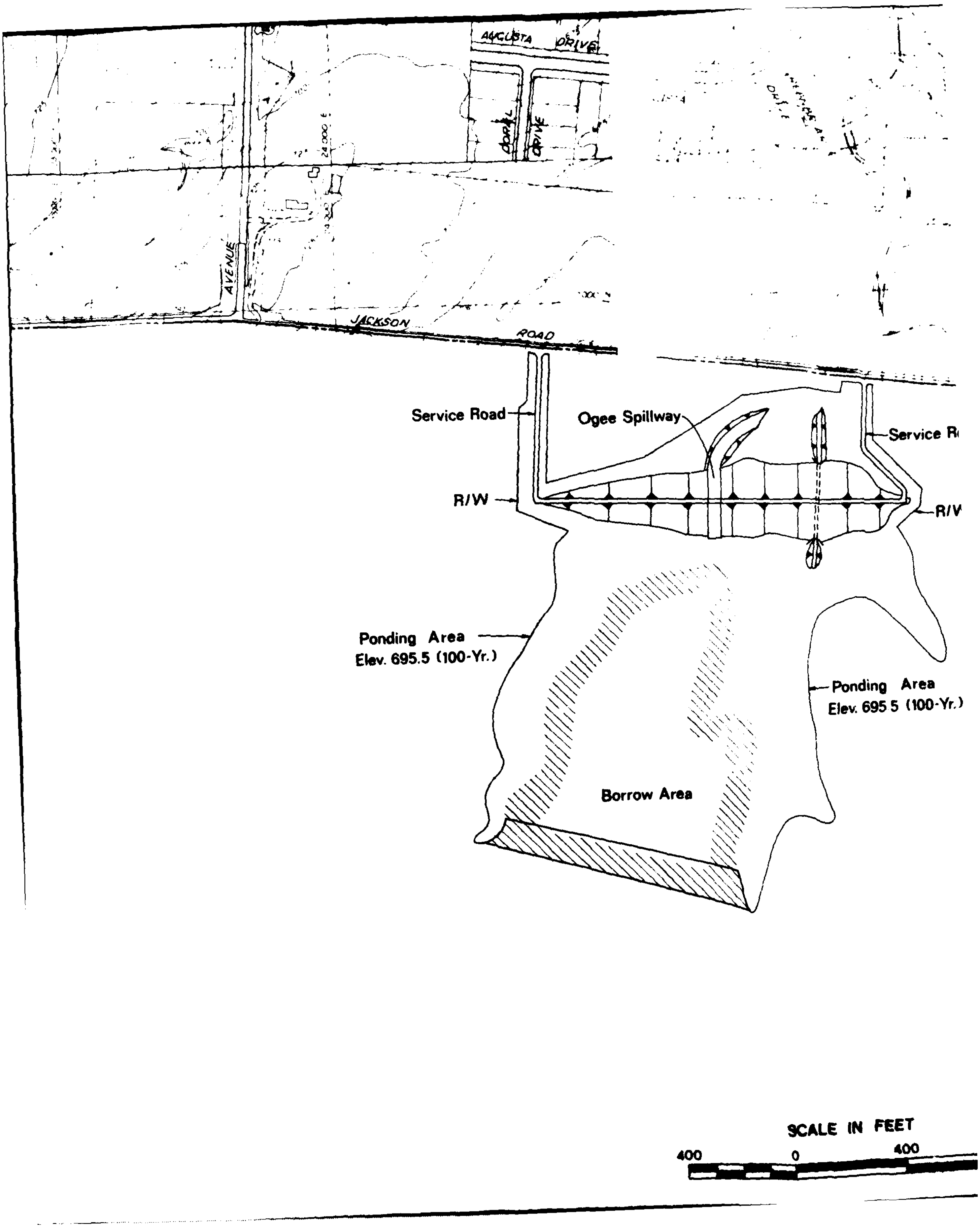
SITE "A"

LOUISVILLE DISTRICT
CORPS OF ENGINEERS
JULY 1981

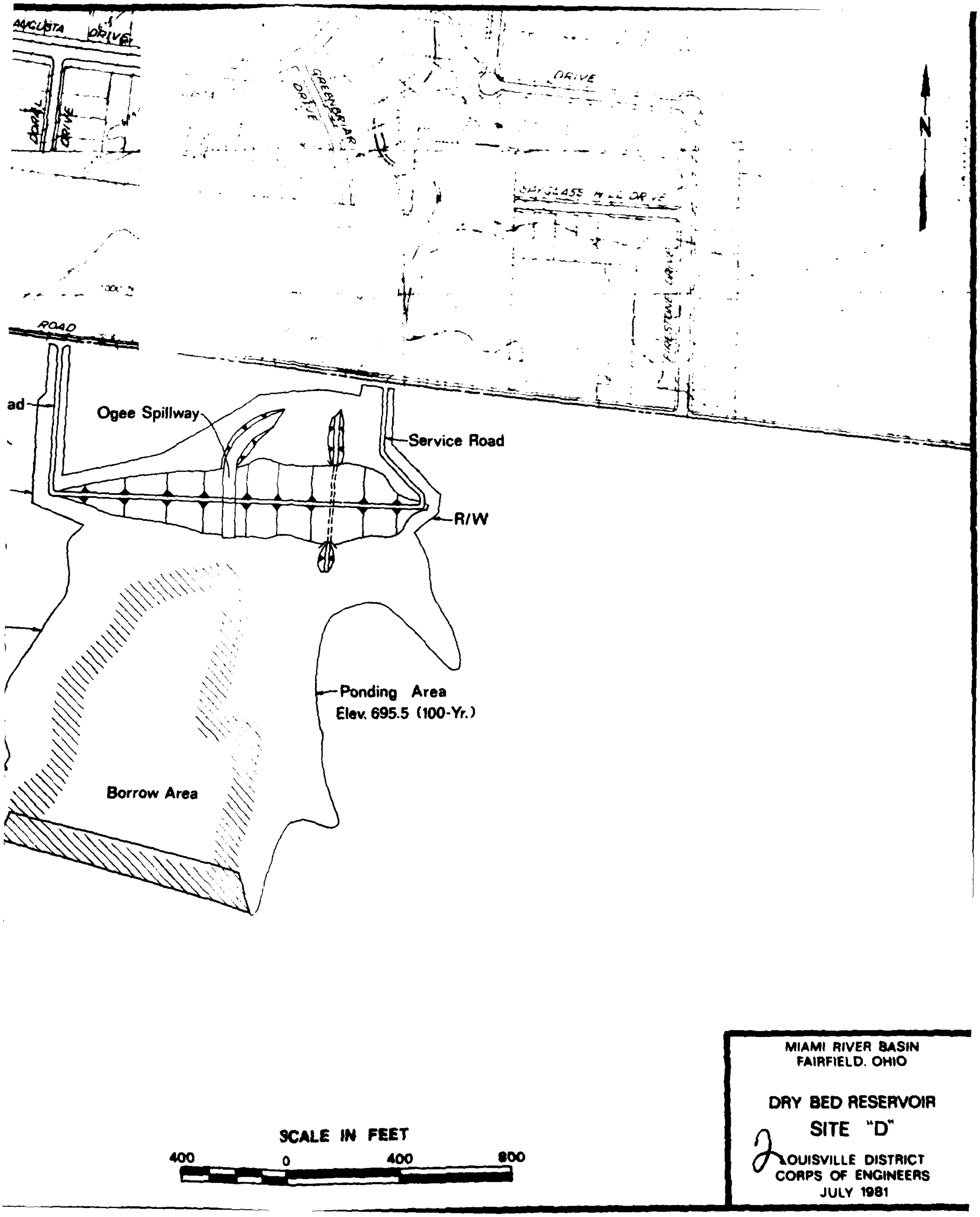

N
R/W
R/W
Ogee Spillway
Service Road
Borrow Area
Ponding Area
Elev. 665.9 (100-Yr.)
SCALE IN FEET
400
0
400
800



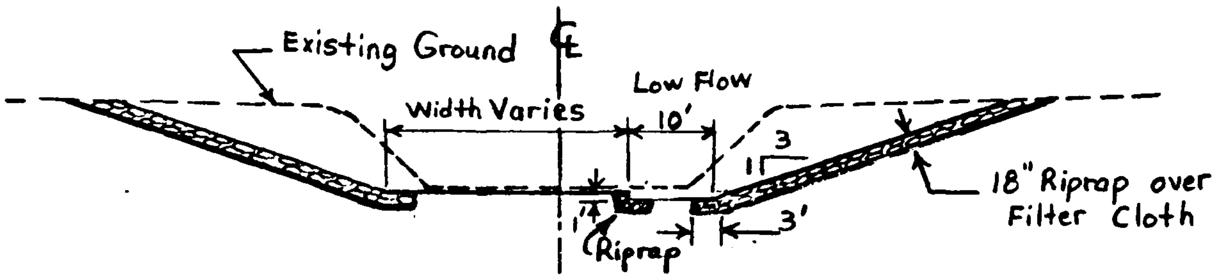
R/W
Service Road
Ponding Area
Elev. 665.9 (100-Yr.)
MIAMI RIVER BASIN
FAIRFIELD, OHIO
DRY BED RESERVOIR
SITE "C"
LOUISVILLE DISTRICT
CORPS OF ENGINEERS
JULY 1981



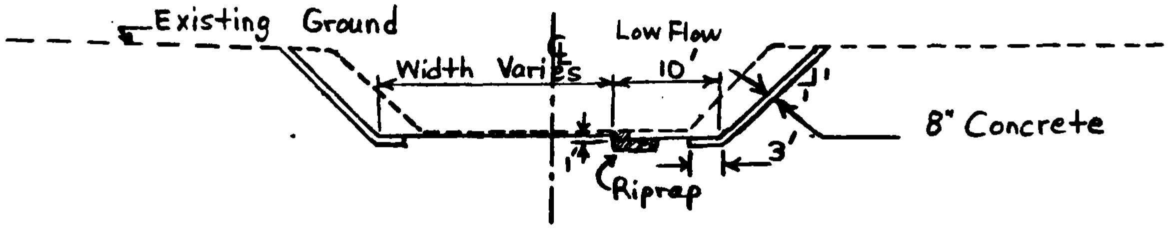
AUGUSTA DRIVE
CORAL DRIVE
AVENUE
JACKSON ROAD
Service Road
Ogee Spillway
Service R
R/W
R/W
Ponding Area
Elev. 695.5 (100-Yr.)
Ponding Area
Elev. 695.5 (100-Yr.)
Borrow Area
SCALE IN FEET
400
0
400



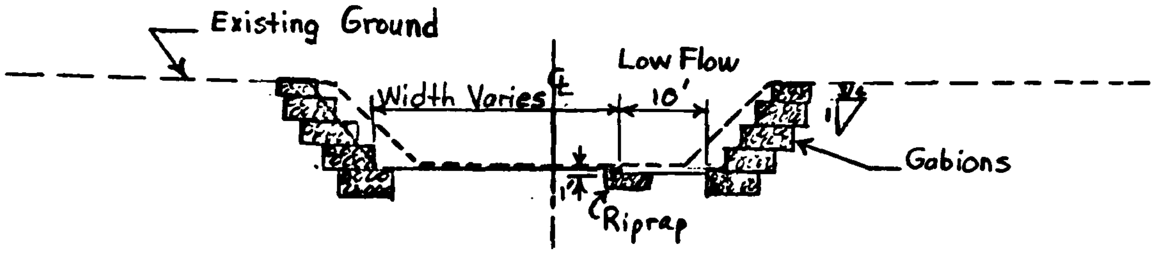
AUGUSTA DRIVE
DORAL DRIVE
GREENBRIAR DRIVE
DRIVE
SPYGLASS HILL DRIVE
FIRESTONE DRIVE
ROAD
N
ad
Ogee Spillway
Service Road
R/W
Ponding Area
Elev. 695.5 (100-Yr.)
Borrow Area
SCALE IN FEET
400
0
400
800
MIAMI RIVER BASIN
FAIRFIELD, OHIO
DRY BED RESERVOIR
SITE "D"
LOUISVILLE DISTRICT
CORPS OF ENGINEERS
JULY 1981



Channel - Riprap



Channel - Concrete



Channel - Gabion

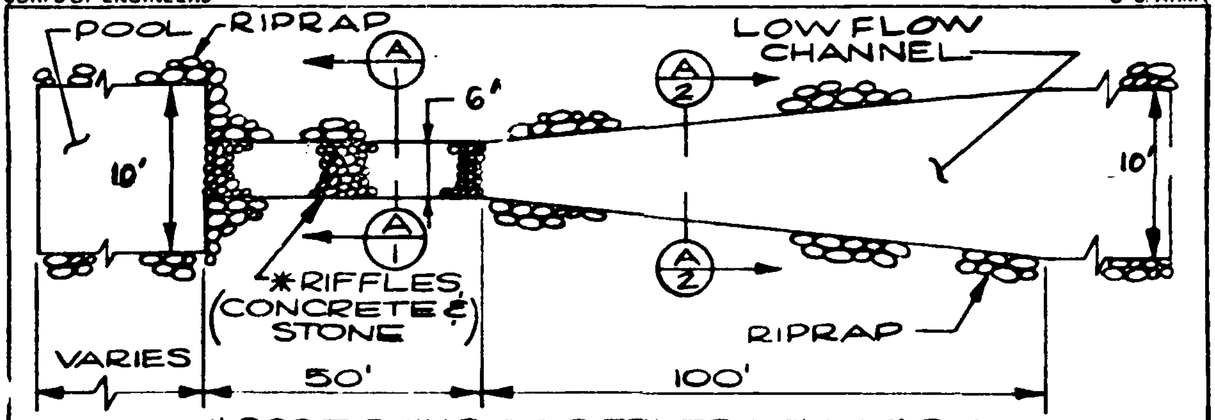
MIAMI RIVER BASIN
FAIRFIELD, OHIO

CHANNEL
TYPICAL SECTIONS

SCALE: 1": 20'

U.S. ARMY ENGINEERS DISTRICT,
LOUISVILLE, KY.

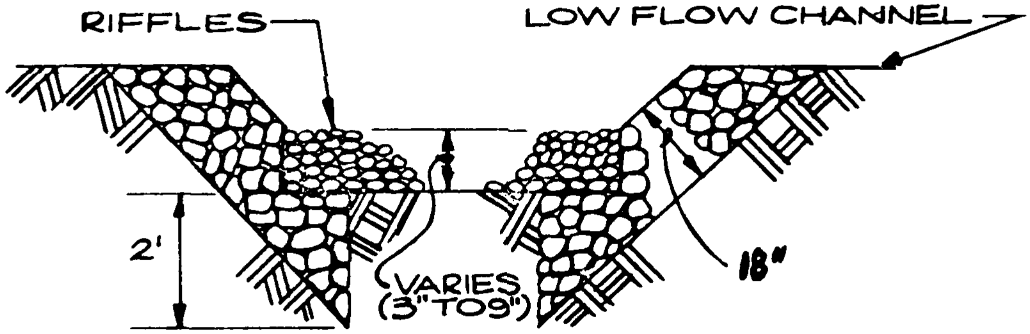
PLATE B-14



*POSITIONING OF RIFFLES WILL VARY ACCORDING TO FISH AND WILDLIFE SERVICE.

TYPICAL PLAN OF LOW FLOW CHANNEL

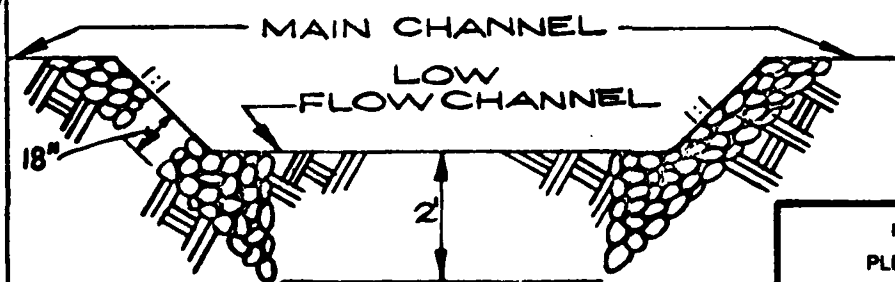
30 0 30 60
SCALE IN FEET



SECTION A/1

RIFFLES

SCALE: NONE



SECTION A/2

LOW FLOW

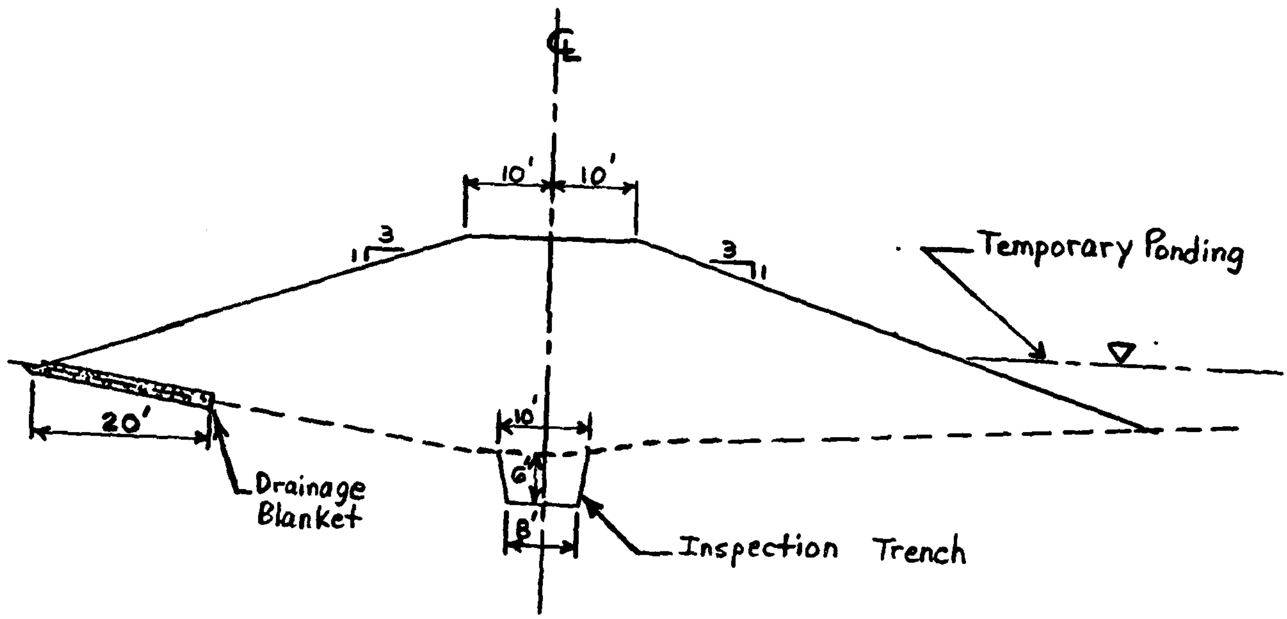
SCALE: NONE

MIAMI RIVER BASIN
PLEASANT RUN CREEK

LOW FLOW CHANNEL

SCALE: 1": 20'

U.S. ARMY ENGINEERS DISTRICT, LOUISVILLE, KY.



MIAMI RIVER BASIN
FAIRFIELD, OHIO

DRY BED RESERVOIR
TYPICAL SECTION

SCALE: 1": 20'

U.S. ARMY ENGINEERS DISTRICT,
LOUISVILLE, KY.

PLATE B-16

APPENDIX C

PUBLIC VIEWS AND RESPONSES

APPENDIX C

PUBLIC VIEWS AND RESPONSES

TABLE OF CONTENTS

SECTION A

PUBLIC INVOLVEMENT

SECTION A
PUBLIC INVOLVEMENT

GENERAL

Public involvement is defined as active public participation for the purpose of determining study goals and objectives and aiding in plan formulation and evaluation. It involves: (a) making sure citizens are thoroughly familiar with how water and water-related problems are determined and solutions proposed; (b) continuously informing the public on study progress and implications; and (c) drawing opinions, perceptions, issues, objectives, information, and other forms of assistance from interested citizens relevant to each study stage. All three of the above objectives are met at each meeting with the public; however, emphasis on the different objectives would vary with the stage of study underway at the time of the meeting.

The public involvement program for this study is described below with comments on the objective emphasized at each meeting.

MARCH 1968 - INITIAL PUBLIC MEETING

In March 1968, an initial public meeting for the parent study - Miami River, Little Miami River and Mill Creek Basins, Ohio - was held in nearby Lebanon. About 100 people attended this meeting, which emphasized furnishing information on the study effort and obtaining views concerning water resource problems.

JUNE 1975 - COORDINATION MEETING

This meeting was held in Fairfield with local officials, Mimai Conservancy District (MCD) and State of Ohio representatives. The meeting was held to inform the attendees of the initiation of the interim study and to invite comments on water resource problems in the area.

NOVEMBER 1977 - COORDINATION MEETING

This meeting was held in Fairfield with local officials, MCD, and Ohio representatives. The meeting was held to discuss the status of the Corps' flood control study on Pleasant Run and its tributaries. Information was also obtained concerning the rapid development of the area.

7 and 8 AUGUST 1979 - FIELD TRIP

Corps representatives made a field trip to Fairfield to get a rough estimate of the extent of the 1 August 1979 flooding. They met with MCD officials to tour the damage areas. The major damage occurred along Banker Drive and Crystal Drive along Pleasant Run Creek.

14 JANUARY 1980 - COORDINATION MEETING

At the request of local officials, Corps representatives attended a City Council meeting and answered questions that the City Council, MCD, or the general public had regarding the study along Pleasant Run Creek in Fairfield.

10 MARCH, 22 MAY, 28 MAY 1980 - COORDINATION MEETINGS

Coordination meetings were held between Corps and MCD representatives to discuss the hydraulics and alternatives for the study.

11 JULY 1980 - FIELD TRIP

Corps representatives made a field trip to Fairfield to observe the flood damages caused by the heavy rains of 8 and 9 July 1980.

28 JULY 1980 - COORDINATION MEETING

A coordination meeting was held between Corps and MCD representatives to discuss the flood protection study at Fairfield. The main topic of discussion was the cost of the alternatives.

5 and 6 AUGUST 1980 - COORDINATION MEETING AND FIELD TRIP

Corps representatives attended a meeting in Fairfield on flood insurance. The meeting was arranged by others to explain the flood insurance program to the City Council and general public. At the request of the general public, Corps representatives visited with several residents in the Banker Drive and Crystal Drive areas to discuss individual flood problems and to obtain a general knowledge about the flooding in this area.

22 SEPTEMBER and 6 OCTOBER 1980 - COORDINATION MEETINGS

Meetings were held between Corps and MCD representatives to coordinate and evaluate the alternatives for flood protection.

20 NOVEMBER 1980 - FORMULATION STAGE PUBLIC MEETING

A plan formulation public meeting was held on 20 November 1980 at the Fairfield Municipal Building. Approximately 60 citizens and officials attended the meeting. Due to the desire of the local officials to have the public meeting in November, there was not sufficient time to send out public meeting announcements. Instead the local officials contacted local news media to announce the meeting. A brochure on the study was made available at this meeting. The presentation included past actions and studies that led up to the meeting and our findings concerning the problems and potential solutions. The main question was: What can be done to shorten the length of time to begin construction?

The majority of those present were either members of the August 1st Alliance (a citizens group seeking flood protection) and officials of the City of Fairfield. The August 1st Alliance favored the three dry bed reservoir plan. A couple of citizens voiced their concern about increased downstream flooding due to the work being done upstream.

26 JANUARY 1981 - COORDINATION MEETING

As a result of the 20 November 1980 public meeting, local officials invited representatives of the Corps and MCD to attend a meeting at Fairfield on 26 January 1981. Corps representatives reviewed the anticipated schedule in regard to time of construction and cost of the project. The local officials also asked what the City could do now so that the project could be constructed in a timely manner.

3 MARCH 1981 - FIELD TRIP

Representatives of the Corps, Fish and Wildlife Service, and MCD made an onsite inspection of Pleasant Run Creek and dry bed reservoir Sites A, B, and D to determine existing conditions as related to channel widening, dry bed reservoir construction, and environmental considerations.

13 MARCH 1981 - COORDINATION MEETING

A coordination meeting was held between Corps and City of Fairfield officials to discuss the status of the study and borrow areas for the dry bed reservoirs.

14 MARCH 1981 - COORDINATION MEETING

A Corps representative met with members of the August 1st Alliance and with a representative of Pleasant Run Farms Civic Association (a subdivision in Hamilton County near dry bed reservoir Site D) to discuss the status of the study.

7 APRIL 1981 - COORDINATION MEETING

Representatives of the Corps City of Fairfield, MCD, and Ohio Department of Transportation met to discuss the Nilles Road bridge and the acquisition of land for dry bed reservoir Site C.

13 MAY 1981 - COORDINATION MEETING

Representatives of the Corps participated in three meetings. The first meeting between MCD and City of Fairfield representatives was primarily about land acquisition for the dry bed reservoir sites. The second meeting with members of the August 1st Alliance concerned the status of the study. The third meeting with several members of the Pleasant Run Farms Civic Association was concerned with explaining the study in general and dry bed reservoir Site ? in particular.

SECTION B

PERTINENT CORRESPONDENCE

City
of
Fairfield

Office of the
City Administrator

James L. Pennington
City Administrator

February 4, 1981

Mr. Neal Jenkins, Chief
Planning Division
Department of the Army
Louisville District Corps of Engineers
P.O. Box 59
Louisville, Kentucky 40201

Dear Mr. Jenkins:

On behalf of the City of Fairfield, let us express our appreciation to the Corps of Engineers Planning staff for their work with regard to the Pleasant Run Creek Flooding problem. The public hearing held on November 20, 1980, along with a meeting held earlier with the Miami Conservancy District staff provided sufficient information for the City Council to make an educated decision with regard to the type of flood control plan to be pursued.

After reviewing the alternatives, the Council has determined that it would like for the Corps of Engineers to proceed with plan development based on three dry bed reservoirs plus limited channel improvements. The reservoir concept was the overwhelming choice over the all channel improvement plans primarily due to the fact that an excessive amount of right-of-way would be required. This would in some cases practically eliminate some backyards and create what is perceived as an extremely dangerous situation.

The dry bed reservoir plan also appeals to the City in that the reservoirs can and sho ld be developed for recreational purposes; thus, utilizing the reservoir areas for flood protection and leisure time activities--a double benefit for the citizens.

In addition to expressing our desire for the Corps to proceed with the dry bed reservoir concept for this project, the City would like to have the Miami Conservancy District act as the local sponsor. This would enable the Miami Conservancy District to be in a position to follow and coordinate the project for the City and then supervise any necessary maintenance after completion.

5350 Pleasant Avenue, Fairfield, Ohio 45014 513 - 867-5300

EXHIBIT C-1
Sheet 1 of 2

The City of Fairfield is hopeful that the Pleasant Run Creek project can be completed in as short a period as possible and that the Corps can assist the City in solving one of its major problems. If there are any questions, please contact the City Administrator's Office.

Sincerely,

James L. Pennington
City Administrator

Thomas O. Marsh
Mayor

JLP:dr

THE MIAMI CONSERVANCY DISTRICT
38 East Monument Avenue
Dayton, Ohio 45402
513 223-1271

September 8, 1981

Colonel Charles E. Eastburn
District Engineer
Corps of Engineers
Louisville District
P. O. Box 59
Louisville, KY 40201

Re: Pleasant Run Project

Dear Colonel Eastburn:

This is in response to your letter of September 2, 1981 regarding the draft report for a flood protection project for Pleasant Run in Fairfield, Ohio.

The Miami Conservancy District staff has reviewed the draft report, environmental impact statement and appendices. The District generally concurs with the recommendation that Plan J, consisting of three dry bed reservoirs and 1.37 miles of channel improvement, be implemented. This plan exceeds the 25% Meyers design standard as proposed by this District in 1964 for channel improvements on tributary streams. Plan J will provide the maximum degree of protection to the largest number of properties while addressing the environmental and social concerns by use of dry reservoirs and minimal channel excavation.

The staff also supports the concept of recreational improvements associated with the flood control project.

The District staff acknowledges the references in the report to the President's proposed cost sharing policy and, should such policy be implemented, will attempt to obtain cooperation from the State of Ohio after the project is authorized by Congress. It should be noted, however, that in Ohio one legislative body cannot bind a succeeding legislature and that it will be necessary for any action by the State to be consummated just prior to initiation of construction.

The District staff encourages the Louisville District to complete final report preparation and obtain approvals from the Ohio River Division and Chief of Engineers at the earliest possible time so that the project can be included in the next public works bill before Congress.

It is understood that subsequent to Congressional authorization and as a basis for the Corps to initiate construction, The Miami Conservancy District will be required to execute a formal local cooperation agreement. Subject to approval of an Official Plan by the District Board of Directors and Conservancy Court, The Miami Conservancy District would be legally and financially capable to accept the requirements of local cooperation as outlined below:

1) Local interests will provide cash or an in-kind contribution in lands, easements and rights-of-way equal to 20 percent of project first cost of flood damage prevention.

2) Pay, contribute in-kind, or repay with interest no less than one-half of the separable first cost of recreation.

3) Hold and save the United States free from damages due to the construction works, but not including damages due to the fault or negligence of the United States or its' contractors.

4) Operate and maintain all works after completion, including the recreational facilities constructed as a part of the project, in accordance with regulations prescribed by the Secretary of the Army and the aforementioned District Official Plan.

5) Administer and assure access to the recreational facilities and lands to all on an equal basis.

6) Prescribe and enforce regulations to prevent obstructions or encroachment on channels and ponding areas which would reduce their flood control purposes or hinder their operation and maintenance.

7) At least annually inform affected interests regarding the limitation of the protection afforded.

8) Comply with applicable provisions of (1) the Uniform Relocations Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646), and (2) Section 601, Title VI, of the Civil Rights Act of 1964 (Public Law 93-352).

Upon authorization of a project for construction by the Congress, The Miami Conservancy District staff is prepared to recommend acceptance and initiate the process required for Official Plan approvals which will allow the District to participate as the representative of the local political subdivisions and thereby provide the requirements of local cooperation.

The Miami Conservancy District staff will continue to cooperate with the Louisville District in every possible way.

Very truly yours,

THE MIAMI CONSERVANCY DISTRICT

By: L. Bennett Coy
L. Bennett Coy
General Manager

cc: The Honorable Thomas N. Kindness
Mr. James L. Pennington
Mr. Lloyd Goggin
Mr. Robert K. Corwin

EXHIBIT C-2
Sheet 3 of 3

United States Department of the Interior
FISH AND WILDLIFE SERVICE
East Lansing Area Office
Manly Miles Building, Room 202
1405 South Harrison Road
East Lansing, Michigan 48823

IN REPLY REFER TO:

Colonel Thomas P. Nack
District Engineer
U. S. Army Engineer District
Louisville
Post Office Box 59
Louisville, Kentucky 40201

Dear Colonel Nack:

This letter supplements our draft Fish and Wildlife Coordination Act report on the local protection project at Fairfield in Butler County, Ohio. This supplement has been prepared under the authority of and in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and in compliance with the intent of the National Environmental Policy Act of 1969.

The newly proposed project as described in your August 8, 1980 letter include both channel enlargement and dry bed reservoirs in the watershed of Pleasant Run, a tributary of the Great Miami River at river mile 30.5. Since submitting our September 27, 1979 draft report you determined that channel improvement measures for GM Ditch, Pleasant Run segment PR-2, and High School Tributary are unnecessary, because recent flood damages were insignificant in areas along these stream segments. Therefore, the new channel plans only include Pleasant Run segments PR-3, 4, 5, and 6. In addition, dry bed reservoirs (Figure 1) are proposed in some plans. The reservoirs would be located on headwaters of High School Tributary (Site A), Winton Road Tributary (Site C), and two on Pleasant Run (Sites D and E). The four proposed sites for the dry bed reservoirs are for the most part wooded. Site A was previously described in our draft report. When compared with the other sites, it has the greatest percentage of mature woodland. Sites B and C include some mature trees along with secondary growth vegetation. Much of the vegetation on site D has been disrupted due to the presence of a power line tower on the site. In general, the wildlife habitat on the four sites is particularly valuable, because of the rapid development in the Pleasant Run watershed. Our draft report should be referenced for a description of the fish and wildlife resources in the project area.

PLANS

Plan 1 includes four dry bed reservoirs (Sites A, C, D, and E) plus a 60-foot wide riprapped channel on PR-6 (0.83 mile). This plan would provide 35-year flood protection.

Plan 2 includes three dry bed reservoirs (Sites A, C, and D) and channel improvement for PR-6 (0.83 miles). Two levels of flood protection are proposed with this plan: 35-year and 100-year.

Plan 3 includes two dry bed reservoirs (Sites C and D) plus channel improvement for reaches PR-3 through PR-6 (2.56 mile). Levels of protection include 35-year and 100-year.

Plan 4 includes a dry bed reservoir at Site D and channel improvement on reaches PR-3 through PR-6 (2.56 mile). Levels of protection include 35-year and 100-year.

Plan 5 includes 25-year and 35-year channel improvement measures for PR-3 through PR-6 (2.56 mile).

Plan 6 includes 100-year channel improvement measures for PR-3 through PR-6 (2.56 mile).

In general, your proposed channel improvement measures include widening of the stream channel in varing amounts, and sloping the streambanks to 2H:1V with riprap or to vertical with concrete. Regardless of the specific width, construction impacts and maintenance easements would result in complete removal of streambank vegetation. Specifications for the four dry bed reservoirs are in Table 1.

DISCUSSION

The adverse impacts to fish and wildlife resources associated with 2.56 miles of channelization in Plans 3, 4, 5, and 6 would be basically the same, regardless of the level of protection. A 100-year channel would be larger than a 35-year channel; however, the difference in impacts to riparian habitat would be relatively insignificant. As stated above, we believe channel improvement measures as proposed would result in the total destruction of riparian vegetation regardless of the level of flood protection. Therefore, we recommend selection of a plan which minimizes the amount of channel modification.

In general, we favor construction of dry bed reservoirs. Such structures are least disruptive to the existing wildlife habitat, and the easements required would prevent development and associated destruction of habitat in the flood ponding area. However, adverse impacts to fish and wildlife resources are associated with dry bed reservoirs. Construction of the dam would result in total destruction of the existing habitat in the affected area. Vegetation would also be removed from the borrow area, which could be in the ponding easement. Selection of the dam site and the borrow area should be coordinated with the State and Federal fish and willdife agencies to minimize adverse impacts to fish and wildlife resources. Loss of vegetation should be replaced with plantings of native species of value to wildlife. We understand the plan preferred by the sponsors is Plan 2. Apparently Site E for a dry bed reservoir has been unofficially eliminated, because of its small capacity for flood water storage and the location of a high voltage line tower on the site.

In summary, we prefer Plans 1 or 2 over the remaining plans, all of which include channelization of 2.56 miles of Pleasant Run. The channel improvement measure for Plans 1 and 2 includes 0.83 mile of Pleasant Run. We believe the construction impacts to this reach could be satisfactorily mitigated.

RECOMMENDATIONS

1. Applicable recommendations (Numbers 1, 3, 5, 6, and 7) made in our September 27, 1979 report should be addressed with the present set of plans.

2. Where practical, selection of the dam sites and borrow areas should be made to minimize damages to fish and wildlife habitat. The selection process should be coordinated with the Ohio Division of Wildlife and the U. S. Fish and Wildlife Service.

3. Disrupted areas due to construction of the dry bed reservoirs should be mitigated with native plantings of value to wildlife.

4. The complete mitigation plan should be coordinated with State and Federal fish and wildlife agencies.

We appreciate this opportunity to provide these comments for your consideration.

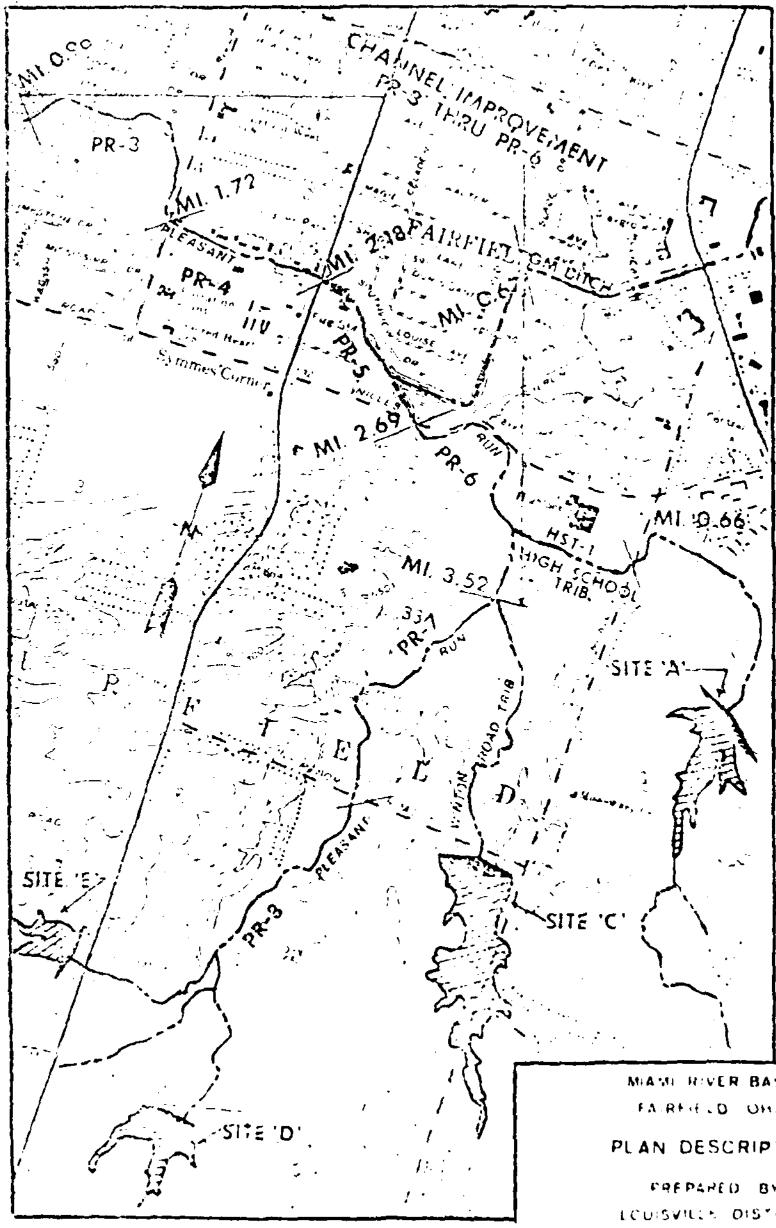
Sincerely yours,

John Popowski
Area Manager

Attachments

Table 1. Summary of data for dry bed reservoirs for Fairfield LPP. All figures are rounded to nearest whole numbers

	Site A	Site C	Site D	Site E
Spillway elevation (ft. above sea level)	660	670	700	710
Top of dam (ft. above sea level)	672	688	714	720
Ponding elevation (ft. above sea level)	659	666	695	706
Right-of-way (acres)	9	11	17	12
Ponding easement (acres)	15	32	13	7
Borrow easement (acres)	12	34	22	14



MIAMI RIVER BASIN
FAIRFIELD, OHIO

PLAN DESCRIPTION

PREPARED BY
LOUISVILLE DISTRICT
CORPS OF ENGINEERS
SEPTEMBER 1980

EXHIBIT C-3
Sheet 5 of 5

United States Department of the Interior
FISH AND WILDLIFE SERVICE
Federal Building, Fort Snelling
Twin Cities, Minnesota 55111

IN REPLY REFER TO
AFF-SE

OCT 3 1980

Colonel Thomas P. Nack
District Engineer
U. S. Army Engineer District
Louisville
P. O. Box 59
Louisville, KY 40201

Dear Colonel Nack:

I have reviewed the Environmental Assessment of Flood Control Alternatives for Pleasant Run Creek in Fairfield, Butler County, Ohio (prepared by PEDCo Environmental, Inc., Cincinnati, Ohio) and find it in sufficient detail to provide comments and a biological opinion.

It appears from the description of the proposed alternative actions that neither Alternative A (Channel Improvements) nor Alternative B (Levee and Walls) will have an adverse impact on the Indiana bat (Myotis sodalis). This is primarily due to the urban nature of the project area and the length of stream to be affected.

Therefore, I concur with the conclusions of staff biologist John Kessler "that the likelihood of listed or proposed to be listed species being in the project area is remote" and it is my biological opinion that Alternatives A or B as presently planned are not likely to jeopardize the continued existence of the Indiana bat.

Sincerely yours,

James C. Gritman

James C. Gritman
Acting Regional Director

EXHIBIT C-4
Sheet 1 of 1

United States Department of the Interior
FISH AND WILDLIFE SERVICE
East Lansing Area Office
Manly Miles Building, Room 202
1405 South Harrison Road
East Lansing, Michigan 48823

IN REPLY REFER TO:

SEP 07 1979

Colonel Thomas P. Nack
District Engineer
U. S. Army Engineer District
Louisville
Post Office Box 59
Louisville, Kentucky 40201

Dear Colonel Nack:

This is our draft Fish and Wildlife Coordination Act report on the local protection project at Fairfield, Butler, County, Ohio, as requested in your letter of April 17, 1978. This report has been prepared under the authority of and in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and in compliance with the intent of the National Environmental Policy Act of 1969.

Pleasant Run is a tributary of the Great Miami River at river mile 30.5. You have presented 12 project alternatives which include approximately 2.9 miles of Pleasant Run, 0.7 mile of High School Tributary and 0.6 mile of General Motors Ditch. These stream reaches flow through residential and commercial areas, with undeveloped areas along 2,000 feet of the left bank of Pleasant Run upstream from Groh Lane and along 4,000 feet of the left bank of Pleasant Run upstream from the Nilles Road bridge. Except for a small segment of High School Tributary along Winton Road, the remaining stream segments have continuous woody vegetation along both streambanks. (see Photos 1, 2, 5, and 6) Thus, despite its basic urban location, the stream has many natural characteristics which provide aesthetic values to local residents as well as food, cover, and nesting areas for fish and wildlife.

FISH AND WILDLIFE RESOURCES

Vegetation along Pleasant Run and its tributaries is typical of riparian plant communities found in the area. Common woody species include boxelder, black locust, hackberry, tree of heaven, sycamore, Osage-orange, black willow, mulberry,

slippery elm, American elm, green ash, pawpaw, Ohio buckeye, bur oak, black walnut, and black maple. Common shrubs and vines include dogwood, wild rose, honeysuckle and grape. Many of the above species, together with a diverse group of herbaceous plant species, provide habitats for songbirds, small mammals, and game animals, such as squirrel, raccoon, rabbit, opossum, and woodchuck.

Physical stream characteristics in the upper portion of the project area are condusive to development of a diverse fishery. (See Photos 2, 3, and 6) The substrate consists of sand-gravel and the gradient is sufficient to maintain ample numbers of pool-riffle complexes. The following fish species were collected from Pleasant Run in July 1978: young-of-the-year smallmouth bass, bluegill, green sunfish, black bullhead, white sucker, creek chub, stoneroller, and carp. The upper reaches were dominated by creek chubs and stonerollers, while the mid-reach (Nilles Road to Pleasant Avenue) had abundant carp. The fishery in the lower reach of Pleasant Run is adversely affected by intermittent flows and degraded water quality. However, we suspect these adverse factors are minimized during the spring high flows, thereby allowing upstream migration of fishes for spawning activities in headwater portions of the stream. In August 1979, we again observed large numbers of minnows (Cyprinidae) in the upper reaches of the watershed. These streams are important suppliers of forage fish to the Great Miami River.

On August 1, 1979, a heavy rainfall in the watershed caused widespread flooding in the residential developments near the confluence of Winton Road tributary and High School Tributary with Pleasant Run. It is apparent that Pleasant Run becomes a "bottleneck" downstream from the converging tributaries. This natural condition has been aggravated by extensive residential development in the watershed to the chagrin of residents of the bottleneck area. Allegations of zoning violations are being made by many affected residents. To compound flood damages, a backup of the sewage system caused additional damage. Photo 4 shows some severe bank erosion which occurred during the flood. We understand your staff is currently assessing water levels to determine the magnitude of the August 1 flood. Since the August flood, the city of Fairfield has been removing debris and substrate material from Pleasant Run in the flooded area downstream to Pleasant Avenue. The flood prevention benefits of this activity should be considered in your subsequent planning of alternatives for this project.

ALTERNATIVES

In response to your June 8, 1979 letter, we have addressed the 12 flood protection plans you provided. We understand that all calculations on channel dimensions are based upon two-sided channel construction. For discussion purposes, stream reaches have been identified on Plate 1, and their lengths are as follows:

Pleasant Run

PR-3	3,750 feet
PR-4	2,325 feet
PR-5	2,750 feet
PR-6	4,000 feet
Total	15,075 or 2.86 miles

General Motors Ditch
GDM-1 3,325 feet
Total 3,325 or 0.63 mile

High School Tributary
HST-1 2,000 feet
HST-2 1,62[illegible] feet
Total 3,625 or 0.69 mile

Plan 1. 25-Year Channel Improvement

This plan includes channelization of all project area stream reaches, except for General Motors Ditch for which snagging and clearing is proposed. Due to the dimensions desired with this channel improvement plan, all streambank vegetation along Pleasant Run and High School Tributary would be destroyed with implementation of this plan. For example, in reaches PR-2 through PR-5, the top width of the improved channel would vary from 110 to 168 feet. Assuming an average width of 8 feet of vegetation on each streambank, approximately 6 acres of high quality riparian habitat would be lost to channel construction. Such habitat is essential as travel corridors for wildlife, as well as providing food and cover. Additional wildlife habitat would be disturbed adjacent to the left bank of PR-2 and PR-6. To obtain the desired stream depth, aquatic habitat (substrate) would be destroyed or modified throughout the 3.55 miles of affected stream reaches. Culverts would be replaced at May Avenue and Doris Jane Avenue along the General Motors Ditch. If snagging and clearing were limited to existing obstructions along this ditch, we believe the adverse impacts to fish and wildlife resources in this tributary would not be significant. In addition to channel modification, this plan would include replacement of bridges at Pleasant Avenue, River Road, and Nilles Road over Pleasant Run; and Crystal Drive and Winton Road over High School Tributary.

Plan 2. 25-Year Channel Improvement

Plan 2 includes measures for the same stream reaches as Plan 1, except that PR-2 through PR-5 would have vertical concrete walls. While this feature would reduce the top width considerably, we believe construction of the wall would necessitate the removal of approximately the same amount of riparian vegetation as Plan 1. In addition to aesthetically reducing the stream to a proverbial storm sewer, this alternative would seriously reduce the utility of the stream by wildlife species which require access to the stream. Also, the concrete walls would have little or no value to aquatic species. Other than replacement of only the Nilles Road bridge, features for the remaining stream reaches of this plan would be the same as Plan 1.

Plan 3. 25-Year Channel Improvement

This plan would use gabions for reaches PR-2 through PR-5 with side slopes of 1 vertical to 0.75 horizontal. Top widths of the improved channel would be intermediate between Plans 1 and 2. Gabions would be more beneficial than

concrete walls for aquatic species and would provide access to the stream for most wildlife species. However, construction of this alternative would result in the loss of riparian habitat throughout the affected reaches. Other features for this plan would be the same as Plan 1.

Plan 4. 25-Year Channel Improvement

This alternative would use gabions for PR-2 through PR-5 and includes small increases in channel widths for all reaches of Pleasant Run and High School Tributary. We believe this alternative would not be significantly different from Plan 3 in terms of adverse effects to fish and wildlife habitat.

Plan 5. 25-Year Channel Improvement

This plan includes the same features as Plan 1 for PR-5 and 6, HST-1 and 2, and GMD-1. Excluding work on General Motors Ditch, this alternative would adversely effect approximately two miles of streams to the same degree as Plan 1.

Plan 6. 25-Year Channel Improvement

This plan includes the same features as Plan 1 for PR-6. This alternative would adversely effect 0.76 mile of Pleasant Run. Most of the August 1 flood damage occurred in this stream reach.

Plan 7. 10-Year Channel Improvement

Channel modifications are proposed for PR-2 through PR-6, or 2.86 miles of stream. The plan would be identical to Plan 1 except that channel dimensions would be significantly smaller and sloped banks would be grassed instead of riprapped. PR-6 would include both grass and riprap. No bridges would be replaced and the existing channel would be deepened under Nilles Road.

Plan 8. 25-Year Channel Improvement

This plan includes the same features as Plan 1 for PR-2 through PR-6, or 2.86 miles of stream.

Plan 9. 25-Year Channel Improvement

This plan only includes features of Plan 1 for GMD-1, or 0.63 mile of stream.

Plan 10. 25-Year Channel Improvement

This plan includes the same features as Plan 1 for HST-1 and 2, or 0.69 miles of stream.

Plan 11. 500-Year Protection - Retarding Structure

This plan includes a retarding structure to be located on the High School Tributary which would have a flood control pool elevation of 656 feet MSL and would have a flood pool surface area of 32.5 acres. If the structure were located on a reach of the tributary which we suspect would be most feasible from an engineering perspective, it would result in the destruction of approximately 15 to 20 acres of mature forests.

Plan 12. 500-Year Protection - Levee and Wall

This plan would require the construction of 2,000 feet of levee and 900 feet of flood wall along a portion of PR-6 and HST-1 with ties to high ground. Based upon your detailed design of this plan, it would have relatively minor adverse impacts upon wildlife resources in the adjacent riverine habitats. Vegetation would be removed from approximately 700 feet along the right banks of Pleasant Run and High School Tributary.

DISCUSSION

Basically, we would have no objections to Plans 9 and 12, as proposed, since adverse impacts to fish and wildlife resources resulting from construction of those plans would not be significant. We observed relatively few obstructions in General Motors Ditch, and the uniform stream bottom could be improved for aquatic fauna by placement of instream structures such as deflectors or sills. The levee proposal in Plan 12 could be mitigated by planting trees and shrubs of value to wildlife between the levee and the stream.

Impacts of other alternatives would vary depending on the length of stream proposed for improvement. Based upon the assumption that two-sided construction using riprap, concrete, or gabions would result in similar destruction of aquatic and riparian habitat; Plans 1, 2, 3, and 4 would have the most adverse impacts to fish and wildlife resources. Of these plans, we would prefer the use of riprap or gabions to concrete streambanks. Plans 7 and 8, which include measures for 2.86 miles of Pleasant Run, would follow in degree of adverse impact. Channel sizes for Plan 7 would be significantly smaller than Plan 8 and, therefore, would result in less damage to the natural environment. Plan 5 includes the same measures as Plan 1 for 2.07 miles of Pleasant Run, General Motors Ditch, and High School Tributary. Plans 6 and 10 would result in similar impacts, with approximately 0.7 mile of stream modification included in each plan.

The retarding structure for Plan 11 should be located to avoid prime woodland areas, which are diminishing due to housing developments near the I-275 outerbelt. If the structure could not be located to minimize impacts to wooded areas, we would recommend a mitigation plan to compensate for losses of wildlife habitat.

RECOMMENDATIONS

To mitigate project-caused losses to fish and wildlife resources for all applicable plans, we recommend the following:

1. Before planning is continued for this project, instream modifications currently under construction by the city of Fairfield should be fully evaluated to determine their potential benefits and/or damage to the flood prone area.

2. Construction should be limited to only those stream reaches which would alleviate flooding conditions in affected areas.

3. Channel improvement measures should be limited to one-sided construction for all alternatives. To retain maximum shading of the stream, construction should be limited to the north bank of the streams.

4. Gabions and riprap should be used instead of concrete walls for constructed side slopes.

5. To partially compensate for loss of riparian vegetation along the reconstructed bank, trees, shrubs, and herbaceous plants of value to wildlife should be planted in the easement areas. Trees which would not impede flood waters should be left on streambanks. To reduce project costs, a tree spade should be used to relocate trees along the constructed streambank.

6. Construction should proceed such that downstream siltation is minimized. All regulation to reduce erosion should be strictly adhered to.

7. Pool-riffle complexes should be constructed throughout project reaches. A minimum numberof pool-riffle complexes should be placed in the following designated stream reaches:

PR-2	2 pool-riffle complexes
PR-3	2 " " "
PR-4	2 " " "
PR-5	2 " " "
PR-6	3 " " "
GMD-1	2 pool-riffle complexes
HST-1	2 pool-riffle complexes
HST-2	" " "

8. To provide additional mitigation, undeveloped areas along the left bank of PR-2 and PR-6 should be placed under a conservation easement for the life of the project. These areas should be managed as natural areas by the city.

We appreciate this opportunity to provide these comments for your consideration.

Sincerely yours,

Area Manager

cc: Chief, ODNR, Div. of Wildlife, Columbus, OH

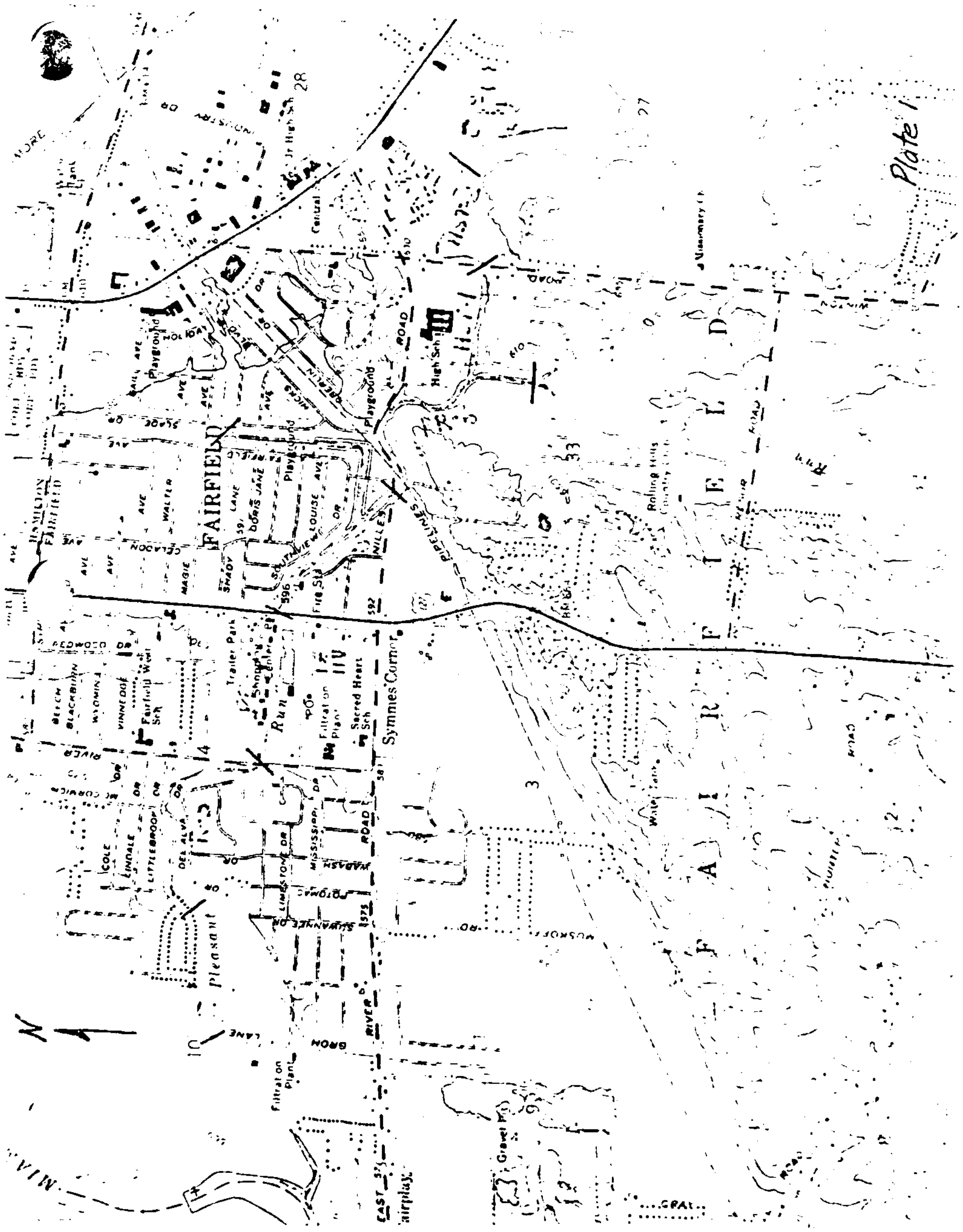


EXHIBIT C-5
Sheet 8 of 11

Photo 1. Pleasant Run downstream from River Road. Turbidity shown on this and subsequent plates due to instream work. Note aeration caused by concrete sill.

Photo 2. Pleasant Run downstream from Pleasant Avenue. Note evidence of gravel removal.

EXHIBIT C-5
Sheet 9 of 11

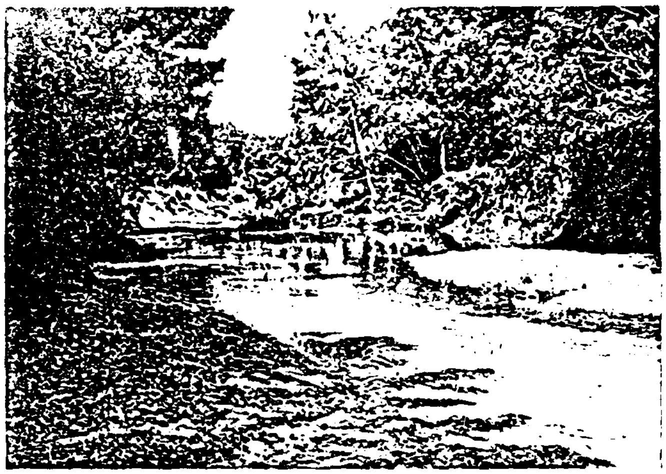


Photo 3. Pleasant Run upstream from its confluence with High School Tributary.

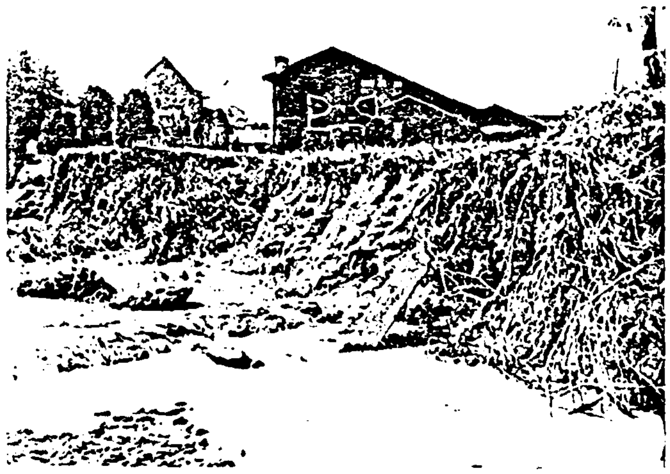


Photo 4. Eroding bank of Pleasant Run aggravated by the August 1 flood. Note housing development in flood hazard floodplain.

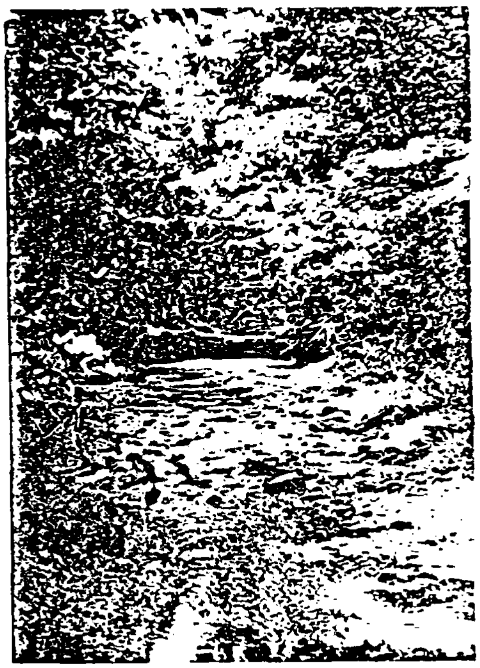


Photo 5. General Motors Ditch downstream from Doris Jane Avenue bridge.

Photo 6. High School Tributary approximately 3,200 feet upstream from Winton Road.

EXHIBIT C-5
Sheet 11 of 11

CITY OF FAIRFIELD

5350 PLEASANT AVENUE, P.O. Box 28 · FAIRFIELD OHIO 45014 · PHONE 867 5383

September 28, 1979

RECEIVED OCT 0 1 1979

Mr. Don Williams
Chief Engineer
Miami Conservancy District
38 East Monument Ave
Dayton, Ohio 45402

Dear Mr. Williams:

Enclosed, you will find copies of Resolution No. 22-79, which was passed on September 24, 1979 by the Fairfield City Council, concerning the petition for creation of a sub-district of the Miami Conservancy.

Also, enclosed is the petition containing 651 signatures from Fairfield, Ohio residents who are supporting the sub-district.

If you have any questions pertaining to the Resolution or the petition, please feel free to call me at 867-5383 between 8:00 a.m. and 5:00 p.m.

Sincerely,

Robert Gerhardt
Admin. Ass't/Clerk of Council

RG/dn

EXHIBIT C-6
Sheet 1 of 2

RESOLUTION NO. [illegible]

RESOLUTION TO PETITION FOR CREATION OF
A SUB-DISTRICT OF THE MIAMI CONSERVANCY
AND DECLARING AN EMERGENCY.

WHEREAS, since the severe flooding of Pleasant Run Creek in August 1979, the City of Fairfield, Ohio has requested the Miami Conservancy District to study and recommend flood prevention measures, and

WHEREAS, Pleasant Run Creek drains portions of Hamilton and Butler Counties in Ohio, and the City of Fairfield, Ohio, and the District needs to ascertain the interest of said Counties in the matter.

NOW, THEREFORE, BE IT RESOLVED by the Council of the City of Fairfield, Ohio:

Section 1: That the Fairfield City Council hereby expresses interest in the Pleasant Run flooding and joins Hamilton County and Butler County in requesting the Miami Conservancy District to expedite afore-mentioned studies.

Section 2: Hereby directs the Law Director of the City of Fairfield, Ohio to petition for the formation of the Pleasant Run Watershed Subdistrict of the Miami Conservancy District to accomplish the fore-going.

Section 3: This Resolution is declared to be an emergency measure for the reason that the health, safety and welfare of the residents of the City of Fairfield, Ohio, require that steps be immediately taken to alleviate flooding of portions of the City, and for that reason this Resolution shall become effective immediately upon its passage.

Passed [illegible]

President of Council Pro-T

Posted [illegible]

First Reading [illegible]

Rules Suspended [illegible]

Second Reading —

Third Reading —

Mayor's Approval (Acting Mayor)

Emergency Measure 7-14-[illegible]

ATTEST:

Clerk of Council

This is to certify that this Resolution has been duly published by posting as is provided by ordinance.

Clerk of Council

EXHIBIT C-6
Sheet 2 of 2

United States Department of the Interior

FISH AND WILDLIFE SERVICE

East Lansing Area Office
1405 South Harrison Road
East Lansing, Michigan 48823

IN REPLY REFER TO:

SEP 28 1978

Colonel Thomas P. Nack
District Engineer
U. S. Army Corps of Engineers
Louisville District
Post Office Box 59
Louisville, Kentucky 40201

Dear Colonel Nack:

This is our preliminary report on the fish and wildlife aspects of the proposed local flood prevention projects at Fairfield, Ohio, as requested in your letters of 18 October 1977 and 17 April 1978. This report has been prepared under the authority of and in accordance with the provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C., 661 et. seq.).

Field investigations were made of the project area on several occasions during the summer 1978. An electrofishing devise was used to sample the stream fishery, and data were gathered on other stream characteristics and riparian vegetation.

Pleasant Run is a tributary of the Great Miami River at river mile 30.5. The area of study includes approximately 3.5 miles of Pleasant Run upstream from its mouth. The stream flows through a residential and commerical area, with a relatively undeveloped area near its confluence with the Great Miami River. Despite its basic urban location, the stream has many natural characteristics which provide aesthetic values to local residents as well as food, cover, and nesting areas for fish and wildlife. Upstream from the Nilles Road bridge, Pleasant Run flows for approximately one-half mile through an undeveloped area along and near the left bank. This area is especially valuable to the fish and wildlife resources. From Nilles Road to Groh Lane, development has encroached to both streambanks; however, for the most part the riparian habitat remains intact.

Vegetation along Pleasant Run is typical of riparian plant communities found in the area. Common species include boxelder, black locust, hackberry, tree of heaven, sycamore, Osage orange, black willow, mulberry, slippery elm, American elm, green ash, pawpaw, Ohio buckeye, bur oak, black walnut, and black maple. Common shrubs and vines include dogwood, wildrose, honeysuckle and grape. Many of the above species, together with a diverse group of herbaceous plant species, provide habitats for songbirds, small mammals and game animals, such as squirrel, raccoon, rabbit, opossum, and woodchuck.

Physical stream characteristics in the upper portion of the project area are condusive to development of a diverse fishery. The substrate consists of sand-gravel and the gradient is sufficient to maintain ample numbers of pool-riffle complexes. The following fish species were collected from Pleasant Run in July 1978: young-of-the-year smallmouth bass, bluegill, green sunfish, black bullhead, white sucker, creek chub, stoneroller, and carp. The upper reaches were dominated by creek chubs and stonerollers, while the mid-reach (Nilles Road to U.S. 127) had abundant carp. The fishery in the lower reach of Pleasant Run is adversely affected by intermittent flows and degraded water quality. However, we suspect these adverse factors are minimized during the spring high flows, thereby allowing upstream migration of fishes for spawning activities to occur in headwater portions of the stream.

As a result of our preliminary investigation, we recommend you consider flood-control alternatives which will not have significant adverse impacts upon the fish and wildlife resources of the area. From a fishery standpoint, we consider Pleasant Run upstream from Nilles Road to be of higher quality. Streambank vegetation along the entire reach of Pleasant Run is an important entity in sustaining wildlife populations along the stream, and providing shade and nutrients to the aquatic life forms.

It will not be necessary for us to conduct in-depth four season studies of the project area prior to preparation of a draft Fish and Wildlife Coordination Act report. Therefore, we believe that a draft report can be submitted in March 1979 within the proposed budgetary funding levels and time constraints agreed upon at our July 25, 1978 meeting.

Sincerely yours,

Raymond G. Oberer

Act'g Area Manager

cc: Regional Director, FWS, Twin Cities, MN (LWR)
ODNR, Div. of Wildlife, Columbus, OH
Supervisor, FWS, CFO, Pickerington, OH (ES)

EXHIBIT C-7
Sheet 2 of 2

CITY OF FAIRFIELD

DEPARTMENT OF ENGINEERING

DONALD B. BRILL
Service Director

CLARENCE 'BUGS' PHALEN
Mayor

TERRY D. DALRYMPLE, P.E.
City Engineer

November 29, 1977

Mr. Neal E. Jenkins
U. S. Army Corps of Engineers
P. O. Box 59
Louisville, Kentucky 40201

Re: Pleasant Run Creek
Improvement Plan

Dear Mr. Jenkins:

This letter is to confirm our comments during the November 18 meeting concerning the improvement plans for Pleasant Run Creek.

The City of Fairfield supports your continued study of the creek and intends to support the construction of improvements in the coming years. In addition to the work which you outlined, we request that you study the possibility of relocating the levee that you plan in the area immediately north of Pleasant Run Creek. It is our opinion that this levee should be located as close to the river as possible so that more land will be available for development. In addition, we request that you furnish recommended bridge openings for the following locations:

1. Groh Lane
2. Happy Valley Drive
3. Augusta Boulevard (the east branch, just above Happy Valley Drive)

You may be assisted in your study of the creek by referring to flood hazard study being prepared by Vogt-Ivers and Associates of Cincinnati for the Department of Housing and Urban Development. Several months ago we received their preliminary map which outlined the flood way and flood fringe for both the Miami River and Pleasant Run Creek.

EXHIBIT C-8
Sheet 1 of 2

Thank you for the opportunity to meet with you on November 18. We continue to support your efforts and will assist whenever possible.

Very truly yours,

Terry D. Dalrymple

Terry D. Dalrymple, P.E., P.S.
City Engineer

TDD:lsr

cc: Donald B. Brill, Service Director
John R. Stenger, Planning Director
William T. Warner, Superintendent
Building Inspection and Zoning
File
M-Reading File

[redacted]

EXHIBIT C-8
Sheet 2 of 2

APPENDIX D
HYDROLOGY AND HYDRAULICS

APPENDIX D
HYDROLOGY AND HYDRAULICS

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APPENDIX D
HYDROLOGY AND HYDRAULICS

This appendix includes basic watershed data, plus the methodology and assumptions used in establishing the hydrologic and hydraulic conditions of Pleasant Run and its tributaries. Frequency profiles were developed on all study streams. Frequency curves were developed at various hypothetical gages on all study streams and related ponding areas adjacent to these streams. From these data, the extent of flooding was determined, flood damages computed, and alternatives evaluated.

BASIN DESCRIPTION

Pleasant Run originates in northern Hamilton County, and flows approximately 8 miles to its confluence with the Great Miami River at Fairfield, in adjacent Butler County. Fairfield is located about 15 miles north of Cincinnati. Pleasant Run drains a watershed of about 14 square miles, and drops about 350 feet from the basin rim to its juncture with the Great Miami River. The upper 5 miles of Pleasant Run flows in a northerly direction, with the next 3 miles flowing in a westerly direction towards the Great Miami River. The lower 3 miles of Pleasant Run lie within the Great Miami River flood plain. However, with the existing upstream retarding structures of the Miami Conservancy District (MCD) in operation, backwater flooding from the Great Miami River is not a significant factor. The flood plain in this lower 2.5

miles of Pleasant Run is totally urbanized. Spoil banks are very much in evidence within this lower 2.5 miles, specifically between Groh Lane (Mile 0.59) and Nilles Road (Mile 2.69). The apparent reason for these spoil banks was the enlargement of the Pleasant Run channel in this reach. The condition of the spoil banks, and the size of the trees on the spoil banks, indicate they have been there for some time. The height of these spoil banks varies from 2 to 4 feet, with the average height being about 3 feet. The upper 5 miles of Pleasant Run above Nilles Road flows through suburban residential areas, which is a major source of the runoff. The drainage area above East Fork tributary is 5.3 square miles, and falls about 290 feet in about 4.5 miles at this point.

A number of tributaries form Pleasant Run. East Fork, High School Branch, and General Motors (G. M.) Ditch are the larger streams in the basin. Flow from East Fork, High School Branch, and Pleasant Run above East Fork comprise the main source of flooding at Fairfield. G. M. Ditch is a flat gradient stream, with a large amount of natural storage area above upper Symmes Road (Mile 2.07). As a result, G. M. Ditch does not contribute significantly to the flooding problem, even though it flows through an industrial, commercial, and residential area.

The East Fork Tributary originates on the southeastern side of Fairfield, and flows generally in a northern direction. Water from the East Fork contributes significantly to the flooding problem of Fairfield. The lower reach of East Fork flows through a highly residential area of suburban Fairfield. The East Fork drains 3.6 square miles of watershed at its mouth, and falls about 310 feet in 4.0 miles from the basin rim to its mouth.

High School Branch originates on the eastern side of Fairfield, and flows approximately 3 miles to its confluence with Pleasant Run. The lower 0.6 mile of High School Branch appears to be a man-made channel. Spoil banks are in evidence in this reach, giving further credence to the man-made channel assumption. The height of these spoil banks varies

from 1.5 to 4.5 feet, with the average height being about 2 feet. The spoil bank below Winton Road is located on the right bank only, whereas above Winton Road, they are on both banks. This reach of High School Branch is also characterized by a wider flood plain than Pleasant Run and East Fork. High School Branch drains 1.5 square miles of watershed at its mouth, and falls about 290 feet in 3 miles from the basin rim to its mouth.

G. M. Ditch also originates on the eastern side of Fairfield, and flows approximately 3 miles to its confluence with Pleasant Run. The lower 1.6 miles appear to be a man-made channel. Spoil banks are also in evidence for the lower 1.2 miles. The height of these spoil banks varies from 2 to 9.5 feet, with the average height being about 3 feet. G. M. Ditch drains 1.5 square miles of watershed at its mouth, and falls about 50 feet in 3 miles from the basin rim to its mouth.

Water from these tributaries would have to flow along the stream gradients, in Table D-1, en route to the Great Miami River.

TABLE D-1

STREAM GRADIENTS

Stream/Reach	Stream Gradient (feet/mile)
Pleasant Run - Groh Lane to Nilles Road	13
- Nilles Road to Resor Road	18
- Resor Road to John Gray Road	33
East Fork - Mouth to Resor Road	35
High School Branch - Mouth to Rt. Bank Apts.	31
G. M. Ditch - Mouth to Dixie Hwy (S. R. 4)	10

Land uses in the Pleasant Run watershed are predominantly residential and commercial, with some industry east of Dixie Highway. The flood plains are primarily occupied by single family residences. The Pleasant Run flood plain between East River Road and Pleasant Avenue (U. S. 127) is occupied by a shopping center and apartments. The High School Branch flood plain east of Winton Road and west of Dixie Highway (S. R. 4) is also occupied by two apartment complexes.

The Pleasant Run watershed has experienced a very rapid growth rate. This growth has been south, because of the physical constraints of the area; the Great Miami River on the west, the city of Hamilton, Ohio, to the north; and the flat uninhabitable lands east of the Baltimore and Ohio Railroad. This growth rate is moving into the upper watershed which produces the high degree of runoff from the Pleasant Run Basin. Not only is Fairfield moving south, the metropolitan area of Cincinnati is moving north. Consequently, the rapid growth rate of the watershed is expected to continue. This rapid growth rate is reflected in the following tabulation. The source of this data is from topographic maps and 1977 aerial photography. Tabulated is the percent urbanization for the calendar years shown.

Calendar Year	Percent Urbanization
1965	10
1974	30
1977	42
1979	50 (Projected)

The projected percent urbanization for 1979 was extrapolated on semi-logarithmic paper for purposes of evaluating the August 1979 flood discussed in succeeding paragraphs.

With the rapid growth of the Pleasant Run watershed, it was necessary to determine future land uses. The local Planning and Zoning Commission for Butler County was contacted in 1977 for this information.

These projections indicated that future land uses would continue to be residential and commercial, and that approximately 90 percent of the watershed would be developed. A map of the basin is shown on Plate D-1.

Bank erosion is in evidence along Pleasant Run. This erosion has occurred primarily downstream of Nilles Road, and in the Banker Road-Crystal Drive area upstream of Nilles Road. In isolated cases, up to 10-15 feet of the bank was lost during the August 1979 flood.

Recent remedial channel work (Feb. 1980-Feb. 1981) has been performed on Pleasant Run by the city of Fairfield since the August 1979 flood. The extent of this remedial work is from downstream of East River Road (about Mile 1.1) upstream to the confluence of Pleasant Run and East Fork (Mile 3.5). The remedial work consisted of widening the bottom width, but not to a constant width. The channel bank slopes were not laid back sufficiently to account for the erosive nature of the soil. The primary point of this remedial work was in Banker Drive-Crystal Drive area of Pleasant Run, which is upstream of Nilles Road. This is the area which has the highest flood damages. The spoil from this remedial work was simply dumped on the banks. No continuous spoil bank was built.

HISTORICAL FLOODS

Significant flooding on Pleasant Run in recent years has been caused by convective storms. Convective storms are typified by the thunderstorm, and are often marked by periods of intense rainfall for short durations, and may be extremely variable in the area covered. Runoff is often increased by antecedent conditions. Flooding on Pleasant Run can also be caused by frontal system storms. Frontal system events are characterized by rainfall that is widespread in coverage, and generally moves up the Ohio River valley on a line from southeastern Missouri to western New York. Again, runoff is often increased by antecedent conditions.

Flooding on the lower portion of Pleasant Run would normally be controlled by the Great Miami River. However, with the regulation from the five upstream MCD retarding structures, flood stages along the Great Miami River have been significantly reduced. A U.S.G.S. gage is located on the Great Miami River about 4 miles upstream of Pleasant Run. The drainage area of this gage is 3,630 square miles. The five retarding structures control 2,709 square miles of this drainage area above the gage, or approximately 75 percent of the watershed at this point. Plate D-1 is a map showing the location of the five MCD retarding structures within the Great Miami River basin, in relation to Fairfield. The map was taken from a report by the Miami Conservancy District, "Restudy of the Official Plan, Part 1 - Development and Verification of a Flood Routing Model of the Miami River Basin," dated June 1964.

The design flood to determine flood control storage for the MCD retarding structures was the March 1913 flood, plus 40 percent increase in rainfall excess. Rainfall totals for the period 23-26 March 1913 varied from 7 inches in the lower part of the watershed to just over 11 inches in the Englewood and Taylorsville Dams watersheds. Plate D-2 shows the rainfall isohyetals for the 23-26 March storm. This plate was also taken from the MCD report of June 1964. These retarding structures have been in operation since 1920.

Except for a few tributaries, the high water of January 1959 caused the highest discharges and stages since the 1913 flood on the Great Miami River. Rainfall totals for this period varied from 3 inches in the upper watershed to 6 inches over the Huffman Dam watershed. An isohyetal map for the 20-21 January 1959 storm is shown on Plate D-3. This plate was also taken from the 1964 MCD report.

The only highwater mark available for the 1913 flood on the Great Miami River in the Hamilton-Fairfield area is at a point 0.7 mile upstream of the existing Hamilton gage. This was the original location of the Hamilton gage, and indicated an elevation of 603 was attained by the 1913 flood. See Plate D-4 for this elevation. Many highwater

elevations were set for the 1959 flood, and are shown as a highway profile on Plate D-4. This reflects regulation of the five MCD retarding structures, whereas the 1913 highwater elevation does not. Plate D-75 shows the 1913 flood which is designated as the 100-year flood event.

No organized streamflow records are available on Pleasant Run. Limited data on past events were obtained from a crest stage just downstream of Nilles Road. This crest stage gage was installed by MCD following a flood in June 1974. However, in August 1979, the most serious flooding occurred at Fairfield, resulting in the installation of a continuous recording gage by MCD at Nilles Road, setting of numerous highwater marks, and a peak discharge estimate by the USGS on Pleasant Run at East River Road. The highwater marks were set on Pleasant Run and the East Fork only. Elevations for these highwater marks were obtained by MCD and Corps of Engineers personnel. Since the installation of this gage, MCD personnel have made several discharge measurements at this gage, and have developed a preliminary rating curve. MCD has used this rating curve to determine peak discharge data for the crest stages collected since 1974. This data, along with the associated rainfall (inches) and storm duration (hours) is tabulated below. The rainfall data was collected at MCD's rainfall station at the Hamilton Sewage Treatment Plant. This sewage treatment plant is located about 2.5 miles north of the Nilles Road gage.

TABLE D-2

HISTORICAL FLOOD DATA

Date	Elevation	Peak Discharge	Storm Rainfall	Storm Duration
	(NGVD)	(cfs)	(Inches)	(Hours)
Feb 1975	591.85	1,500	3.00	30
Jan 1976	591.50	1,300	0.95	6
Oct 1977	593.73	2,850	4.50	8
Jan 1978	592.45	1,950	1.23	28
Aug 1979	596.89	5,200	1.91	2
Sep 1979	594.96	3,700	5.00	8

Although only 1.91 inches of rainfall was recorded at the sewage treatment plant on 1 August 1979, amounts up to 3.43 inches were recorded in the upper watershed for the same 2-hour period. Rainfall amounts were high for the month of July 1979. About 5.1 inches were measured at the sewage treatment plant. Of this total, about 2.4 inches fell between 24-29 July in the vicinity of the Pleasant Run watershed. Consequently, on 1 August, the ground was relatively saturated, thereby cpable of producing a high percentage of runoff. The maximum intensity measured at the sewage treatment plant was 0.82 inch in a 15-minute period. The average rainfall above the Nilles Road gage for 1 August 1979 storm was about 3 inches. Assuming that the rainfall occurred over the Pleasant Run watershed above Nilles Road in a similar pattern to that recorded at the Hamilton Sewage Treatment Plant, the storm would appear as follows:

Time	Rainfall (inches)
3:00 PM	0
3:00 - 3:15	1.29
3:15 - 3:30	0.14
3:30 - 3:45	0.38
3:45 - 4:00	0.24
4:00 - 4:15	0.56
4:15 - 4:30	0.32
4:30 - 4:45 PM	0.07
Total	3.00

Rainfall totals from Technical Paper No. 40, "Rainfall Frequency Atlas of the United States," show the following values for return intervals of 10-, 25-, and 100-years at Fairfield:

Duration (hours)	Rainfall (Inches) 10-Yr.	25-Yr.	100-Yr.
30 minutes	1.5	1.8	2.2
1	1.9	2.2	2.8
2	2.4	2.7	3.3
3	2.6	3.0	3.6
6	3.1	3.5	4.1

The isohyetal rainfall pattern for the 1 August 1979 storm is shown on Plate D-5 for the Pleasant Run watershed. Additional precipitation gages east of the Pleasant Run watershed were used to shape the isohyetal pattern. However, these stations were not shown.

As mentioned before, numerous highwater elevations were obtained in connection with the 1979 flood. These highwater elevations are shown on Plates D-6 through D-9 for Pleasant Run and East Fork.

No stage hydrograph data are available for the 1979 flood. However, residents in the area of Nilles Road have indicated that water began spilling out of the banks 1 to 2 hours after the storm began. This indicates that Pleasant Run is an extremely fast rising stream.

ASSESSMENT OF AVAILABLE DATA

Streamflow information for the Great Miami River at Hamilton, Ohio, is published in U.S. Geological Survey Water Resources Data for Ohio. Gage heights and several discharge measurements were furnished by MCD. Collection of base data began in 1907 and extends to the current year. One historical gage height is available for 1898. The flow has been regulated by the five MCD retarding structures since 1920. The gage is located on the right bank 1,000 feet downstream from the Columbia Bridge at Hamilton, and 4 miles upstream of Pleasant Run.

This and two other similar gages were used to develop regional curves for 10-, 50-, 100-, and 500-year events for the Great Miami River. The period of record used for the study was from 1920 through 1975. The regional discharge data for the Great Miami River were coordinated with the Butler County, Ohio FIS. The hydrologic and hydraulic analyses for this study were performed by Woolpert Consultants of Dayton, Ohio, for the Federal Insurance Administration (FIA). The hydrologic analysis for the Great Miami River was coordinated with MCD. The discharges used in the Butler County study were those discussed above. The frequency profiles for the Great Miami River at the mouth of Pleasant Run are shown on Plate D-10.

No stream gage records are available for Pleasant Run or its tributaries. The only streamflow information available was obtained from MCD, and was discussed under Historical Floods.

Flood frequency profiles were developed on Pleasant Run and its tributaries in conjunction with the city of Fairfield, Ohio FIS. The hydrologic and hydraulic analyses for this study were performed by Vogt, Ivers and Associates, Inc., of Cincinnati, Ohio, for FIA. This work was completed in August 1977. Peak discharges were determined through the use of Ohio Department of Natural Resources (ODNR), Bulletin Nos. 32 and 43, which were prepared in cooperation with the USGS and the Ohio Department of Transportation. These bulletins basically reflect rural runoff. The flood frequency profiles were developed using HEC-2. The highwater elevations for the August 1979 flood were plotted on these frequency profiles, and found to plot at and above the 100- and 500-year profiles. Because of the rural nature of the source for discharges, and also for the lack of highwater elevations for an historical flood, these profiles were not considered reliable for this study.

Precipitation values are published in NOAA's (National Oceanic and Atmospheric Administration) Climatological Data. The following recording gages (hourly information) are available:

Hamilton Sewage Treatment (MCD gage)
Hamilton-Fairfield, Ohio
Cincinnati Abbe USMO, Ohio

Nonrecording gages (daily information) are available for the following locations:

Hamilton 2, Ohio
Kings Mill, Ohio
Milford Water Works, Ohio
W. Fork Mill Creek Dam, Ohio

These gages were representative of general coverage storms for the Pleasant Run watershed. However, thunderstorm activity may not be described adequately by these gages alone. This is evidenced by the 1 August 1979 event where additional rainfall totals from local residents were necessary to obtain a complete definition of rainfall totals.

The regular topographic maps (1:24,000) were of sufficient accuracy to determine watershed drainage areas, subwatershed drainage areas, and stream mileages. Detailed mapping (2-foot contour intervals, 1" = 400 feet) was obtained from the city of Fairfield, Ohio. This detailed mapping indicated the latest subdivisions, supplemented the cross sections discussed below, and provided greater reliability for other engineering and economic studies.

Cross section data on Pleasant Run and its tributaries were collected in 1974 and 1977. MCD collected additional cross sections subsequent to the August 1979 flood, and made these available to our office. These data were combined to calibrate the HEC-2 computer model to the August 1979 flood. Subsequent to the August 1979 flood, the city of Fairfield performed remedial channel clearing and widening on Pleasant Run from Groh Lane (Mile 0.6) to the confluence with East Fork (Mile 3.5). The city of Fairfield applied for this work under the 404 Permits Program. Additional cross sections from Groh Lane (Mile 0.60)

to East Fork (Mile 3.50) were obtained in March 1981 to reflect this remedial channel work.

RAINFALL - RUNOFF PROCEDURES

The lack of recorded streamflows, increasing land use changes, and the impact of the proposed drybed reservoirs dictated the development of a rainfall-runoff model to represent the watershed. A model was constructed for the Pleasant Run watershed above Nilles Road only; more specifically, at a point just downstream of High School Branch (Mile 3.3). This basin was divided into subbasins as shown on Plate D-11. The model was not extended downstream of this point because of diversion and ponding at location 1, diversion flow over the spoil banks at location 2, ponding and weir flow at location 3, and spill at locations 4, 5 and 6 below E. River Road. Flow also spills out of G. M. Ditch at Doris Jane Avenue, and flows generally west, mainly through the streets, at location 1A. These locations are shown on Plate D-11 as hatched areas. Movement of water in these areas were studied using weir flow, slope-area computations using Manning's frequency, and inflow-outflow storge routings using HEC-1.

The rainfall-runoff model for the Pleasant Run waterhshed down through High School Branch was constructed using the HEC-1 Flood Hydrograph Package. SCS dimensionless unit hydrographs based on the time of concentration were used to represent runoff regimes for each subbasin. The time of concentration for each subbasin was calculated using either previous HEC-2 computer runs, slope area computations using Mannings equation for an average channel, or overland flow using nomographs for the particular land use. Sometimes a combination of all three were used. The computation interval used for this model was 15 minutes.

Loss rates were based on SCS curve numbers. The values reflect land use in each subbasin (as determined by the 1977 aerial photography and automobile tour of the area) and hydrologic soil type (as determined from the Butler and Hamilton Counties Soil Maps).

The model generated by the techniques described above was verified by comparison with data collected during the August 1979 event mentioned previously. This event was chosen because it was the only well documented flood on Pleasant Run. The available information included highwater marks, 15-minute rainfall, and reliable estimates of peak discharges at two locations. Both discharge locations are downstream of the HEC-1 model, and both reflect diversion, weir flow, and storage routings. The U.S. Geological Survey computed a peak discharge of 5,430 cfs at East River Road. This computation was made using the contracted opening procedure, plus weir flow over East River Road in the left overbank. MCD determined the peak discharge at Nilles Road to be 5,200 cfs. This determination was made based on highwater marks and extrapolation of their rating curve through these highwater marks. Based on the pattern rainfall shown on Plate D-5 the best reproduction using the HEC-1 model was 5,850 cfs at East River Road and 5,350 cfs at Nilles Road. This considered diversion flow, weir flow, and HEC-1 storage routings at locations 1 through 3.

HEC-2 backwater models on Pleasant Run and East Fork were developed to reproduce the highwater marks on these streams. Discharges used in these HEC-2 models were those generated from the HEC-1 model, diversion, weir flow, and multiple storage routings below High School Branch. Channel roughness coefficients of 0.042 to 0.055, and overbank values from 0.040 to 0.100 were required to reproduce a majority of the highwater marks shown on Plates D-6 through D-9. The flood profile shown on Plates D-6 through D-9 is the best calibration obtained from the data generated by HEC-1 and HEC-2.

The discussion on rainfall-runoff procedures, thus far, has been concerned with the watershed at a point just below High School Branch (mile 3.3). The flow regime of Pleasant Run below mile 3.3 is not adaptable to modeling procedures within HEC-1. A description follows, regarding the flow patterns below mile 3.3, at all locations of either subbasin transfer, spoil bank weir flow, or storage-outflow routings at natural ponding areas. The areas discussed below are shown on Plate D-11.

LOCATION 1 - This is the first point where water spills out, and flows into a subbasin, G. M. Ditch. This is located at Pleasant Run mile 2.91 on the right bank. The water flows into a natural ponding area by way of Hicks Boulevard and Dennison Drive. Water begins spilling out of Pleasant Run at elevation 601.5 (NGVD), or at a discharge rate of 4,200 cfs. Flow into this temporary ponding area was determined by rating curves on Pleasant Run at mile 2.91 and spillover rating down Hicks Blvd. This spillway rating was computed using weir flow, and checked by normal-depth computations, using Manning's equation. Plate D-12 shows the rating curves used at this location, and represents conditions at the time of the August 1979 flood. Utilizing the flow hydrograph data from HEC-1 just below High School Branch, an inflow hydrograph into the ponding area for any event could be hand-computed. In addition, the net flow down Pleasant Run was also determined. The peak discharge down Pleasant Run, of 5,350 cfs after spillover, matches very closely with the peak discharge estimated by MCD, of 5,200 cfs at Nilles Road. The spillover hydrograph into the temporary ponding area was then routed through storage using HEC-1 procedures. The outlet point for this storage routing was by way of Doris Jane Avenue at G. M. Ditch. Outflow was two directional at this point. Using rating curves, flow was combined with G. M. Ditch, and also found to flow down streets west of G. M. Ditch, by way of Doris Jane Avenue. The peak discharge of 5,850 cfs agrees very well with the total peak discharge estimated by U.S.G.S. of 5,430 cfs at East River Road. This estimate of 5,430 cfs was broken down by the U.S.G.S. into 4,250 cfs channel flow, and 1,180 cfs weir flow over East River Road south of Pleasant Run.

LOCATION 2 - This is the second point where water spills out, and flows into a temporary ponding area. This is a triangular-shaped residential area bounded by Pleasant Run to the northeast, Nilles Road to the south, and Pleasant Avenue to the west. The spillover is located just downstream of G. M. Ditch, at about mile 2.52, on the left bank. The water spills into this area by way of intermittent spoil banks. Water begins spilling into this area at elevation 596.7 (NGVD), or at a

discharge rate of 5,900 cfs on Pleasant Run. No water spilled out in the August 1979 flood since flow at Nilles Road, plus flow from G. M. Ditch, equaled 5,850 cfs. However, floods greater than the August 1979 flood will occur; thus the procedure will be covered here. Spill at this location was computed in a manner similar to LOCATION 1. The spillover hydrograph should be routed through ponding storage, utilizing HEC-1. The outflow point for routing will be Pleasant Avenue. A rating curve at Pleasant Avenue was computed using weir flow. Flow west of Pleasant Avenue is sheet flow, and does not contribute to flooding until it approaches East River Road.

LOCATION 3 - This is a temporary ponding area upstream of East River Road, north of Nilles Road, and south of Pleasant Run. Flow into this ponding area is outflow from LOCATION 2 plus backwater from Pleasant Run along a ditch running along Nilles Road and East River Road. Flow from this drainage ditch was not considered for two reasons: the size of the drainage ditch watershed (less than 0.5 square mile), and available ponding south of Nilles Road, before LOCATION 3 is reached. The outflow point for LOCATION 3 is East River Road, south of Pleasant Run. The outflow rating was assumed to be weir flow over East River Road. Again minimal storage was available, and HEC-1 storage routings indicated outflow equal inflow. Peak flow over East River Road was computed to be 1,200 cfs for the August 1979 flood, or a depth of about 6 inches over the road. This agrees very closely with the U.S.G.S. estimate of 1,180 cfs over East River Road.

LOCATION 4 - This location is downstream of East River Road where Pleasant Run turns west towards the Great Miami River. Water did not spill out during the August 1979 flood, but will for higher intensity storms. Spill from this location combines with spill from LOCATION 3 to cause flooding in the general left overbank area between East River Road and Suwanee Drive. Some of this spill then finds its way into the newer subdivision area between Suwanee Drive and Groh Lane, along East River Road. Flow into this area was determined in a manner similar to LOCATION 2. Depth of flooding was by the normal-depth routine. A

ponding area exists at the intersection of Potomac and Limestone Drives. Minimal storage is available, so HEC-1 storage routings were not made.

LOCATION 5 - This point is at Mile 0.94, about 1,800 feet upstream of the Groh Lane bridge. Water begins to spill out into the left bank about elevation 570.5 (NGVD), or a discharge rate of 2,500 cfs. The spill rating was determined by HEC-2 routings independently of the channel HEC-2 routings. They began at a point south of the Groh Lane bridge, and were computed using critical depth flow at the first section. This spill (or divided flow) rejoins Pleasant Run below Groh Lane.

LOCATION 6 - This is the final point where water spills out of banks, and is on the right bank, immediately upstream of Groh Lane (Mile 0.60). Water from this spill does not return to Pleasant Run. Water begins to spill out about elevation 567.0 (NGVD), or a discharge rate of 3,100 cfs. The August 1979 flood did not spill out at this location. Spill at this location was determined in a manner similar to LOCATION 1.

With the rapid growth of the Pleasant Run watershed, it was necessary to consider future land uses. Local officials and agencies were contacted to see if any regulations were in effect controlling the runoff from future development. These officials indicated there have been regulations on the books for some time, but have not been strictly adhered to. For example, only one small retarding basin (about 60 acres, or 0.1 square mile) has been built. The Fairfield officials are not aware of additional retarding structures planned for the upper Pleasant Run watershed. Consequently, the Butler County Planning and Zoning Commission was contacted for its projections of future land uses. These future land uses are residential and commercial, and indicate that approximately 90 percent of the watershed in Butler County would be developed. Hamilton County was not contacted for its land use plans in the Pleasant Run watershed. However, it appears the same land uses are developing as in Butler County. Therefore, it was assumed that

90 percent of the Pleasant Run watershed in Hamilton County would be developed for residential and commercial purposes.

The next step was to overlay these projected land uses on the Pleasant Run watershed. In doing this, it was found that no future land uses are projected for G. M. Ditch. Even if they were, the large amount of flood plain storage above Symmes Road, mile 2.1, would moderate the effects of this development. Consequently, runoff conditions for G. M. Ditch will remain the same. The anticipated increased runoff is expected to come from the upper Pleasant Run, East Fork, and High School Branch basins.

Only those subbasins having projected land uses were changed. These projected land uses resulted in quicker response times and increased storm runoff. Those subbasins not affected by these projected land uses were not changed. These unaffected subbasins were generally in the lower part of the model watershed.

FLOOD PROBABILITY

Profiles for the 10-, 50-, 100- and 500-year events on the Great Miami River were available from previous studies bv other agencies. A brief discussion of their determination was given in Assessment of Available Data.

Since Pleasant Run streamflow records were not available for statistical analysis, flood probabilities were based on results from the rainfall-runoff model.

Rainfall frequency values for durations from 30 minutes to 24 hours, and return intervals from once every year to once every 100 years were obtained from Technical Paper 40 and Technical Paper 49 by the Weather Bureau, U. S. Department of Commerce. 500-year values were extrapolated from these data. However, because of the very short watershed response

time, durations greater than 2 hours did not appreciably increase peak discharges. The time of concentration that was discussed in Rainfall-Runoff Procedures indicates it takes about 2 hours to travel from the rim of the basin to the vicinity of High School Branch. Therefore, the maximum 2-hour storm rainfall for each return interval was used in the HEC-1 computer model to determine discharge frequency data.

The 15-minute precipitation increments were arranged in a sequence based on a study of six area storms of record. These storms occurred in January 1959, March 1964, May 1968, July 1973, June 1974, and August 1979. The items investigated, and the resulting average percentages are given in the following tabulation. The percentages did not vary greatly among the seasons of the year.

TABLE D-3

STORM PERCENTAGES

Item	Percent Adopted
Percent of total storm length used for the initial loss	25
Percent of total storm rainfall considered as initial loss	15
Percent of total storm length considered as the main part of the storm	40
Percent of total storm rainfall considered as the main part of the storm	80

Flood probabilities were based on rainfall probabilities with adjustment in loss rate determination. As stated earlier, SCS curve numbers were used for rainfall loss calculations. Streamflow calculations using HEC-1 with 15-minute computation intervals were computed

for storms with 1-, 2-, 5-, 10-, 25-, 100-, and 500-year return intervals. Type II (normal) antecedent conditions were assumed for events up to and including the 2-year flood. Type III (wet) antecedent conditions were assumed for the 10-year and larger floods. An antecedent condition midway between Types II and III was assumed for the 5-year event. Varying the curve numbers to account for different antecedent conditions is based on the logic that large events normally occur when conditions favor runoff. More common events often occur with average soil conditions. The frequencies where the transitions take place were estimated from experience with other studies.

No changes were made to the 15-minute rainfall distribution in changing from a Type II to Type III antecedent condition when future land uses were incorporated. As discussed under Rainfall-Runff Procedures, only those subbasins having projected future land uses were changed, and these changes were shorter response time and new curve numbers to reflect the future land use. Plates D-13 through D-21 show the natural discharge-frequency curves on Pleasant Run, East Fork, High School Branch, and G. M. Ditch for both present (1979) and future land uses.

Verification of this procedure is founded on a comparison with the limited historical information for the August 1979 flood. Conditions at the beginning of the August 1979 flood indicated the ground was in a wet condition, corresponding to Type III conditions. Satisfactory reproduction of this storm was obtained with these curve numbers, as attested to the calibration of the 1979 flood discussed under Rainfall-Runoff Procedures. The 2-hour rainfall total for the August 1979 storm indicates it to be greater than a 25-year event, as shown by the rainfall data discussed under Historical Floods. The August 1979 storm, according to residents, reached the highest elevations since the January 1959 flood. The discharge-frequency curves for Pleasant Run at East River Road and Nilles Road show the 1979 flood to be slightly greater than a 25-year event; see Plates D-13 and D-14.

No other flood of lesser magnitude has sufficient rainfall, discharge, or highwater data to verify the HEC-1 model. However, a regional discharge frequency study was performed in connection with Flood Insurance Studies for Preble, Montgomery, Shelby, and Miami Counties, Ohio. WRC guidelines were adhered to for this regional analysis. This study included streams in urbanized areas, and also considered the parameters of drainage area, average watershed slope, and percent urban development. Over 20 stream gaging stations were used in the regional analysis. A skew coefficient of -0.2 best fitted the data, and is the same skew coefficient adopted for an earlier, and a more comprehensive, Indiana regional frequency study.

Plates D-22 and D-23 show the 10- and 100-year discharge versus drainage area curves, respectively, derived from the above study. For drainage areas greater than 20 square miles, a series of parallel lines were formed for long term gages. For drainage areas less than 10 square miles, there was sufficient long term data to develop a relationship of 10- and 100-year discharges to percent urbanization and average basin slope. Results from other studies for 10 square miles or less (Jefferson County, Kentucky; Marion County, Indiana; and Hamilton County, Ohio) show that these two factors were important influences on frequency discharges, and that a series of parallel lines was formed for different streams. The slope of the parallel lines was selected by first plotting all 100-year discharges computed in the gage analysis for long term stations, and checking it against the slopes for the January 1959 discharges, Plate D-24. The 1959, 10- and 100-year curves have essentially the same slopes. The values assigned to the curves for 10 square miles and less are the percent urbanization and the average basin slope (feet per mile) above the gaged point, respectively.

As of 1979, about 50 percent of the Pleasant Run watershed above Nilles Road had been urbanized. The average basin slope above Nilles Road is about 65 feet per mile. The 10- and 100-year discharges generated by HEC-1 for Pleasant Run just below High School Branch are 5,450 cfs and 9,250 cfs, respectively, for present (1979) conditions. When

plotted on Plates D-22 and D-23, they match reasonably well with the percent urbanization and basin slopes for gaged areas below the 100 square miles. This was considered reasonable confirmation of the frequency discharges generated for Pleasant Run by the HEC-1 computer model.

The discussion on flood probabilities, thus far, has been concerned with the watershed at a point just below High School Branch. For the area below this point, the procedure discussed under Rainfall-Runoff Procedures was followed for all return intervals, present and future land uses, and any flood control alternatives studies. Only those return intervals were studied which exceeded the channel capacities for the alternative degrees of protection studied.

Modified flood conditions reflecting possible channel improvement, drybed reservoirs, or a combination of channel improvement and drybed reservoirs were determined by the following procedure.

1. A preliminary set of profile computations was run for a range of flows using the HEC-2 stream models modified to represent the plan being studied.

2. Rating curves were drawn for the drybed reservoir outflow points of storage routing reaches used in the rainfall-runoff model, and at points of spill downstream of the HEC-1 model. Ratings curves were drawn for both natural and modified conditions.

3. The HEC-1 model was modified to reflect reservoir routing procedures. The Modified Puls routing procedure was used, where outflow is a function of storage and therefore of storage indication. Rainfall-runoff calculations were performed using HEC-1 with the modified stage-outflow tables. This step gave modified discharges for Pleasant Run, East Fork, and High School Branch. Flows downstream of the HEC-1 model, where spill occurs, were determined in a manner identical to that used for natural conditions.

4. A final set of modified profile computations were then run using HEC-2 with the modified flow rates.

The selected plan includes three drafted reservoirs and channel improvement downstream of these structures to give future 100-year degree of protection. These three sites are shown on Plate D-11. Modified streamflows for this selected plan are shown on Plates D-13 through D-21.

Natural and modified elevation-frequency curves for selected locations are shown on Plates D-25 through D-42 on Pleasant Run, East Fork Pleasant Run, High School Branch, and G. M. Ditch. Both present and future land uses were considered. Also shown on these plates are the modified curves for the selected plan (100-year degree of protection with three drybed reservoirs). Plates D-25 to D-30, D-34 to D-38, and D-41 and D-42 graphically illustrate those reaches where spill occurs. These elevation-frequency curves were based on results from HEC-2 water surface data, weir flow ratings over roads and spoil banks, and storage routings using HEC-1. Rating curves were utilized in all cases, both natural and modified.

STANDARD PROJECT FLOOD

The Standard Project Flood (SPF) is a hypothetical flood that might be expected to occur from the most severe combination of meteorological and hydrological conditions that are considered reasonably characteristic of the geographic region involved, excluding rare combinations.

Standard Project Flood flows for Pleasant Run were computed with the HEC-1 rainfall-runoff model. Precipitation was distributed according to EM 1110-2-1411. An index precipitation of 12.1 inches and a transposition area of 10.9 square miles (including High School Branch) was

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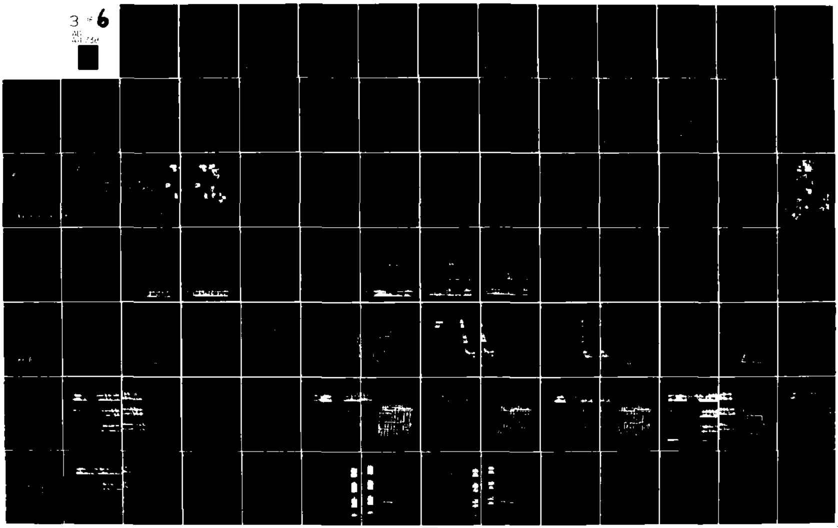

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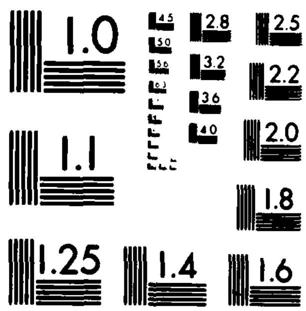

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used. Type III antecedent conditions were assumed in loss determinations. Flows below High School Branch, where a number of spills occur, were calculated with procedures identical to those described previously. Both present and future land uses were considered in the HEC-1 model. Basic results in Table D-4 indicated that the present and future SPF flows are essentially equal.

TABLE D-4

PRESENT AND FUTURE SPF DATA

Item	Land Uses	
	Present	Future
Total storm rainfall (inches)	12.63	12.63
Total storm runoff (inches)	11.26	11.68
Pleasant Run peak discharge below High School Branch (cfs)	16,600	17,300
Pleasant Run peak discharge at John Gray Road (cfs)	5,000	5,400
East Fork at Resor Road (cfs)	6,000	6,500
Average difference in elevation on Pleasant Run and East Fork (ft)		+0.2

For the above reasons, only those reflecting future land uses were utilized.

Plate D-43 illustrates the future natural SPF discharge and elevation hydrographs on Pleasant Run just below High School Branch. Also shown on this plate is the rainfall distribution for the SPF. Although shown as hourly values, 15-minute duration rainfall was used to compute the SPF hydrograph. The elevation hydrograph was based on results from HEC-2 water surface data. A rating curve was developed at mile 3.25 to convert discharge to elevation.

SPF discharges for natural conditions at selected locations on Pleasant Run, East Fork, High School Branch, and G. M. Ditch are given in Table D-5.

TABLE D-5

STANDARD PROJECT FLOOD DISCHARGES

Stream/Location	Discharge (cfs) Future Natural	Future Modified (100-Yr. Selected Plan)
Pleasant Run		
Groh Lane	3,300	3,200
East River Road	7,400	6,900
Nilles Road	8,300	7,400
Below High School Br.	17,300	11,000
Resor Road	8,700	5,600
John Gray Road (drybed Site "D" upstream of road)	5,400	3,900
East Fork		
Mouth	6,800	3,700
Resor Road (drybed Site "C" upstream of road)	6,500	3,500
High School Branch		
Mouth	3,400	1,700
Drybed Site "A"	2,600	1,200
G. M. Ditch		
Mouth	2,400	1,300

WATER SURFACE PROFILES

Water surface profiles were calculated using an HEC-2 computer model. Cross sections used to describe stream geometry were obtained from field surveys, and detailed contour mapping. All structural data was also field surveyed, such as road profiles, bridge openings, low flow structures, etc. Sixty cross sections in all were field surveyed, and average of almost seven sections per mile. Areas that would be ineffective in conveying water downstream were not included. Typical cross sections are shown on Plates D-44, D-45 and D-46.

Verification of this model was accomplished in conjunction with verifying the rainfall-runoff procedure. Calculated streamflows were inserted into the HEC-2 models for Pleasant Run and East Fork. The resulting profiles were compared with known highwater information for the 1 August 1979 flood. Plates D-6,-7, -8 and -9 show the reproduced profiles on Pleasant Run and East Fork. Roughness coefficients for High School Branch and G. M. Ditch were based on field estimates. The roughness coefficients after channel dredging and some widening were based on photographs of the area. Table D-6 gives channel roughness coefficients required to reproduce the August 1979 flood on Pleasant Run and East Fork, estimates adopted for High School Branch and G. M. Ditch, and estimates for channel rectification from mile 2.91 to East Fork by the City of Fairfield.

Table D-6 shows a difference between the present and future natural channel coefficients for the reach of Pleasant Run from Mile 2.91 to the East Fork. The present natural coefficients reflect channel condition of the dredging at the time of March 1981 field inspection. In regard to future natural conditions, it was assumed minimal maintenenace would be performed on this channel reach. To account for this assumption, the channel coefficient was increased by about 10 percent to 0.045. This value is in line with other channel coefficients on Pleassant Run.

TABLE D-6

MANNING'S COEFFICIENTS

Location	Coefficients Channel	Lob	ROB
Pleasant Run			
Below East River Road	0.044	.050	.050
Between E. River Road and Pleasant Ave.	0.043	.050	.050
Between Pleasant Ave. and Nilles Road	0.040	.050	.050
Nilles Road to Mile 2.91	0.044	.125	.050
Mile 2.91 to East Fork	0.050	.060	.050
	.037 - .041 1/	.060	.050
	0.045 2/	.060	.050
East Fork to Resor Road	0.047	.060	.060
Resor Road to John Gray	0.055	.070	.070
East Fork			
Mouth to Resor Road	0.048	.060	.060
High School Branch			
Mouth to Damsite	0.055	.050	.050
G. M. Ditch			
Mouth to S. R. 4	0.045	.060	.060

1/ Channel coefficient for present natural.
2/ Channel coefficient for future natural.

Water surface profiles were computed by starting headwater floods on Pleasant Run with slope-area computations at mile 0.20 on Pleasant Run, and assuming a flat pool backwater from the Miami River at the lower end. The floods on the Miami River and Pleasant Run were not assumed to be coincident. Slope-area computations were assumed for G. M. Ditch and High School Branch in relation to Pleasant Run. Coincident flooding was assumed on East Fork because of the similar size drainage areas of both streams. Present and future natural frequency profiles for Pleasant Run, East Fork, High School Branch, and G. M. Ditch are shown on Plates D-47 through D-57. The SPF flood profile is shown only for future conditions, as discussed previously.

Modified conditions (100-year Selected Plan) were modeled using the channel improvement option (CHIMP) in the HEC-2 program. Under the selected plan, some minor work was required below East River Road, replacement of East River Road was required, the first 800 feet upstream of East River Road was enlarged, and the reach from Nilles Road to East Fork Tributary was also improved. No channel work was required for East Fork, High School Branch, or G. M. Ditch. Channel improvement consisted of gabion structures below East River, the width of the East River Road bridge was increased to 60 feet with vertical walls, and the first 800 feet of channel upstream of East River Road was enlarged as a riprap channel. The channel upstream of Nilles Road was enlarged using a riprap channel with a concrete wall for the first 1,000 feet upstream. Roughness coefficients of .040 were used for a completely riprapped channel, and .015 for that reach where concrete was required. Plates D-58 through D-62 show the modified future flow profiles including those for the SPF. These also reflect flow reductions from the three dry bed reservoirs. Plate D-76 shows the 100-year and SPF limits for future conditions. Plate D-77 shows the SPF modified by Plans H and J and Plate D-78 shows the 100-year flood modified by dry bed reservoirs A, C, and D.

DEGREE OF PROTECTION

The amount of flood control storage for the three drybed reservoirs is dictated by site constraints at each location. Tables D-7, D-8 and D-9 give area-capacity data for each site. The Pleasant Run site above John Gray Road, Site "D," reflects "borrow-area" fill. The "borrow" begins at elevation 685, which is 16 feet below the spillway crest elevation of 701 (NGVD). Plate D-66 reflects the before and "after-borrow" conditions. Sites on High School Branch (Site "A") and East Fork (Site "C") did not require excavation to maintain flood control pools.

TABLE D-7

AREA-CAPACITY DATA
DRY BED RESERVOIR "A"
HIGH SCHOOL BRANCH

Elevation (ft. msl)	Area (acres)	Storage (Acre-feet)	Storage Inches of Runoff
638	0	0	0
640	0.2	0.2	0.004
642	0.6	1.0	.02
644	1.5	3.1	.06
646	2.8	7.4	.14
648	4.3	14	.26
650	5.8	25	.46
652	7.7	38	.70
654	9.8	56	1.03
656	11.9	77	1.42
658	13.9	103	1.89
660	14.5	132	2.43
662	16.8	163	3.00
664	20.1	200	3.68
666	23.8	244	4.48
668	27.7	295	5.42
670	31.2	354	6.51
672	35.7	421	7.74

Reservoir Drainage Area = 1.02 Sq. Mi.

TABLE D-8

AREA-CAPACITY DATA
DRY BED RESERVOIR "C"
EAST FORK

Elevation (ft. msl)	Area (acres)	Storage (Acre-feet)	Storage Inches of Runoff
632	0	0	0
634	0.3	0.3	0.002
636	1.0	1.6	.01
638	1.7	4.3	.03
640	2.3	8.3	.05
642	4.0	15	.09
644	5.0	24	.14
646	6.6	35	.21
648	8.2	50	.29
650	10.0	68	.40
652	12.0	90	.53
654	14.5	117	.69
656	17.0	148	.87
658	19.5	185	1.09
660	21.8	226	1.33
662	25.0	273	1.61
664	28.0	326	1.92
666	32.0	386	2.27
668	36.5	454	2.67
670	41.2	532	3.13
672	47.0	620	3.65
674	52.0	719	4.23
676	57.5	829	4.88
678	63.0	949	5.58
680	68.6	1,081	6.36
682	75.0	1,224	7.20
684	81.5	1,381	8.12
686	87.0	1,549	9.11
688	93.0	1,729	10.17
690	97.4	1,920	11.29

Reservoir Drainage Area = 3.19 Sq. Mi.

TABLE D-9

AREA-CAPACITY DATA
DRY BED RESERVOIR "D"
PLEASANT RUN (WITH BORROW)

Elevation (ft. msl)	Area (acres)	Storage (Acre-feet)	Storage Inches of Runoff
664	0	0	0
666	0.1	0.1	0.001
668	0.3	0.5	.003
670	0.5	1.3	.01
672	1.0	2.8	.02
674	1.7	5.5	.04
676	2.5	9.7	.06
678	3.6	16	.11
680	5.0	24	.16
682	6.1	36	.24
684	7.5	49	.32
686	12.0	69	.46
688	19.8	100	.66
690	27.2	147	.97
692	28.8	203	1.34
694	30.5	263	1.74
696	32.5	326	2.15
698	34.5	393	2.59
700	36.8	464	3.06
702	39.1	540	3.56
704	42.4	621	4.10
706	45.7	710	4.69
708	48.0	803	5.30
710	50.8	902	5.95
712	54.8	1,008	6.65
714	58.8	1,121	7.40

Reservoir Drainage Area = 2.84 Sq. Mi.

The amount of flood control storage for each site was based on a 500-year event, 6-hour duration storm. The 15-minute computation intervals were arranged in the same order as discussed under "Flood Probability." A 4-foot diameter concrete pipe was used at each site to determine outflow from the damsite. This is the size pipe ultimately selected for each site. Plate D-64 shows the conduit rating curve for Site "C." HEC-1 was used to route the future 500-year, 6-hour duration storm through each site. Tabulated in Table D-10 are the results of these routings at each site. The pool elevation have been rounded to the nearest foot. Also tabulated is the amount of flood control storage in inches based on these routings.

As discussed under "Flood Probability," all discharge-frequency data was based on a 2-hour duration storm. All frequency floods were routed through the dry bed reservoirs as part of the HEC-1 studies. Results of these reservoir routings (peak pool elevations) are plotted on the design flood profile Plates D-60, D-61 and D-62. As expected, they plot below the spillway crest elevation.

TABLE D-10

FLOOD POOL DATA

Site/Location	Spillway Crest Elev.	Flood Control Storage (inches)
Site "A" on High School Branch	662	3.00
Site "C" on East Fork	671	3.39
Site "D" on Pleasant Run	701	3.31

A further test was made as to the adequacy of the flood control storage tabulated above. The storm-type used reflects intense rainfall for short time periods (2 hours), or a convective-type storm. The storms of March 1913 and January 1959 reflect a storm-type with less intense rainfall over a short time period, but more rainfall spread out over a longer time period. These two storms were input to the HEC-1 model and routed through the three drybed reservoirs. At no time did either flood exceed spillway crest. Tabulated below are the peak pool elevations for the March 1913 and January 1959 events. Also tabulated is the length (hours) and total storm precipitation used in the HEC-1 model.

Storm Event	Total Precip. (Inches)	Storm Duration	Pool Elevations (NGVD)		
			Site "A"	Site "C"	Site "D"
March 1913	10.6	96 hr	655.0	667.3	697.2
January 1959	5.5	34 hr	650.0	666.1	695.7

From the above discussion, sufficient flood control storage is available to control both types of storms that have occurred, or could occur in the Pleasant Run Basin. The frequency of spillway operation for Sites "A," "C," and "D" is set at the 500-year frequency flood. Only the Standard Project Flood and Spillway Design Flood (SDF) exceeded spillway crest at each dry bed reservoir site.

The future 100-year flood, as modified by the three drybed reservoirs, was selected as the degree of protection for channel improvement. Higher degrees of protection would have been prohibitive from the standpoint of costly real estate purchases, structural replacements, and environmental impacts on the residential areas below Nilles Road. In addition, extremely high velocities are not realized in this area, thereby foregoing design to the SPF level. Lower degrees of protection

are economically justifiable, but do not call for channel work in areas where erosion of the banks are severe. The 100-year degree of protection addresses these erosion problems below East River Road and was therefore favored by the City of Fairfield.

The SPF does not have any adverse impacts downstream of the three drybed reservoirs, despite spillway flow. Plate D-43 shows the modified discharge and elevation hydrographs at Mile 3.25 on Pleasant Run. No increase in flooding occurs; in fact, the time of flooding duration is greatly reduced; see Plate D-43.

The SPF on Pleasant Run and its tributaries is in excess of a 1,000-year frequency flood. Consequently, a SPF would cause flooding conditions in the overbanks under the 100-year selected plan. Table D-11 is a tabulation of SPF velocities for existing and selected plan conditions at specific points within the study reach. There would also be residual flooding in the ponding area under the selected plan. Table D-12 is a tabulation of SPF elevations for existing and selected plan conditions. They are referenced to elevation-frequency curve reaches (such as PR-5) rather than by stream mileage.

TABLE D-11

STANDARD PROJECT FLOOD VELOCITIES
FOR NATURAL AND SELECTED PLAN

Stream Mileage	Velocities (fps) 1/ Left Overbank	Channel	Right Overbank	Location/Comments
Pleasant Run				
0.60	1.2 2/ 1.2 3/	6.7 2/ 6.3 3/	0 2/ 0 3/	Upstream of Groh Lane at Spill Point 6.
1.34	1.5 1.4	8.2 8.15	3.3 3.1	Near Spill Point 4, where erosion problems exist, ang gabions to be used for stabilization.
1.97	2.5 2.1	8.5 7.2	1.7 1.3	Halfway between Easts River Road and Pleasant Ave., at shopping center.
3.25	3.6 1.1	8.7 9.4	4.8 4.1	In reach PR-6, by Crystal-Banker Drives.
3.63	3.5 3.4	4.6 6.1	2.9 3.1	Just upstream of East Fork.
4.90	4.8 3.8	9.5 8.8	3.9 2.8	Downstream from Happy Valley Drive.
5.50	3.7 3.3	8.1 7.8	0 0	Upstream of Augusta Blvd.

TABLE D-11 (Continued)

Stream Mileage	Velocities (fps) 1/ Left Overbank	Channel	Right Overbank	Location/Comments
East Fork				
0.13	3.3 2/ 2.4 3/	5.8 2/ 5.0 3/	3.1 2/ 2.1 3/	Upstream of Chesapeake Way.
0.75	5.2 4.3	12.1 11.9	4.87 2.4	Downstream of Resor Road
High School Branch				
0.31	2.2 2/ 1.0 3/	5.8 2/ 4.9 3/	0 2/ 0	Downstream of Winton Road.
0.62	0 0	5.2 5.0	2.6 1.3	Vicinity of right bank apartments.
G. M. Ditch				
0.57	0.5 2/	3.7 2/	0 2/	Upstream of Doris Jane Avenue.

1/ Velocities represent future flows.
2/ Future Natural Velocities
3/ Modified by 100-yr. selected plan, with three drybed reservoirs.

TABLE D-12

STANDARD PROJECT FLOOD PONDING ELEVATIONS
FOR NATURAL AND SELECTED PLAN
(FUTURE FLOW CONDITIONS)

Reach	Natural	Selected Plan
PR-2	572.5	572.2
PR-3	576.5	576.0
PR-3A	577.7	577.0
PR-5	593.4	592.8
PR-9, 13A	593.6	592.4
PR-10	599.5	598.3
PR-11	596.3	595.0
PR-12	580.6	579.4
PR-13B	597.5	597.0
GM-1A	604.6	601.4
GM-1B	602.6	600.4

CHANNEL STABILITY

The Pleasant Run channel consists of gravel and sandy soil deposits, with sandy banks. Consequently, bank erosion is a major problem. Specific areas are above Nilles Road and below East River Road. In some localized reaches, as much as 10-15 feet of the bank has been lost. The Selected Plan will address these specific problems. Proposed stabilization measures consist of gabions in the reach below East River Road, riprap between East River Road and the shopping center, and a riprap channel above Nilles Road to East Fork. To forego relocating Nilles Road, plus cutting into the hill on the left bank, a concrete wall is to be used for the first 1,000 feet upstream of Nilles Road. The design discharge used to determine the type and size of these channels was the 100-year future discharge modified by the three drybed reservoirs. Table D-13 is a tabulation of bottom widths, channel side slopes, and velocity data for the 100-year (design flood) and SPF. The channel velocities were extracted from the HEC-2 computations.

Where riprap is required, EM 1110-2-160 design criteria was followed. The required riprap is a 12-inch layer (minimum size permitted) of graded stone, W_{50}, 5 to 11 pounds. This size will withstand channel velocities greater than a 100-year flood. However, the final design will be made during the advance engineering and design phase and the adequacy of the stone protection will be checked for the channel velocities generated by the standard project flood.

TABLE D-13

DESIGN CHANNEL DATA
SELECTED PLAN
(100-YEAR FUTURE FLOWS
MODIFIED BY 3 RESERVOIRS)

Stream Mileage	Type Channel	Bottom Width (feet)	Channel Side Slopes (ft/ft)	Channel Velocities 100-Yr. (fps)	Channel Velocities SPF (fps)
Pleasant Run below East River Road					
0.94	Gabion - Lt. Bk.	34	.75H:1V	5.6	5.7
1.03	Gabion - Lt. Bk.	36	.75H:1V	9.2	9.8
1.14	Gabion - Lt. Bk.	30	2H:1V	8.1	8.5
1.34	Gabion - Lt. Bk.	36	.75H:1V	8.3	8.5
Pleasant Run above East River Road					
1.73	Riprap	40	2H:1V	5.6	5.7
1.86	Riprap	40	2H:1V	7.4	9.3
Pleasant Run above Nilles Road					
2.72	Concrete	50	1H:1V	5.8	6.7
2.91	Concrete	50	1H:1V	6.4	7.4
3.03	Riprap	50	2H:1V	5.8	8.8
3.14	Riprap	50	2H:1V	7.3	9.8
3.25	Riprap	50	2H:1V	7.5	9.4
3.34	Riprap	55	2H:1V	6.5	8.2
3.50	Riprap	60	2H:1V	8.2	10.7

PROJECT IMPACTS

The moderating effect of the drybed reservoirs reduced flood flows downstream of the reservoirs. These modified flows (future conditions only) are shown on Plates D-13 through D-21. Implementing a 100-year future channel plan reduces the stages on Pleasant Run to those shown on profile Plates D-58 through D-62. One adverse impact is the slower release rates caused by the drybed reservoir concept. While reducing flood flows, a longer inbank flow duration can be expected. However, this will be a matter of hours, and not days. This may have a negative effect on the erosion problems experienced on Pleasant Run. Maintenance of the channel reaches not improved by the Selected Plan should be enforced, especially after sufficient ponding in the reservoirs.

Ponding levels behind each drybed reservoir will have impacts on land uses in these areas. The duration of ponding varies from 12 hours for a 2-year event to 24 hours for a 500-year event. The duration of ponding for a SPF is 52 hours.

FREEBOARD ALLOWANCE

The spillway design flood was routed through each drybed reservoir, beginning at spillway crest elevation, or full pool. No wave runoff was calculated according to EM 1110-2-27, since each dam is very small with respect to pool area at top of dam. The 3-foot minimum freeboard is considered adequate for these small detention sites. Subsequent studies will determine if the need exists to arbitrarily increase the freeboard to 5 feet. Table D-14 shows the results of spillway design flood routings for each drybed reservoir. Also shown is top of dam elevation, after adding the 3-foot minimum freeboard.

TABLE D-14

TOP OF DAM DATA

Site Location	SDF Pool Elevation	Top of Dam Elevation
Site "A" on High School Branch	669.2	673
Site "C" on East Fork	685.2	688
Site "D" on Pleasant Run	709.8	713

SPILLWAY DESIGN FLOOD

The Probable Maximum Flood (PMF) was used as the Spillway Design Flood. The PMF is a hypothetical flood that might be expected to occur from "the theoretically greatest depth of precipitation for a given duration that is physically possible over a particular drainage area at a certain time of year," (American Meteorological Society, 1959).

Probable Maximum Flood flows for each drybed reservoir site were computed with the HEC-1 rainfall-runoff model. An index precipitation of 24.8 inches and a transposition area for each site was used. Type III antecedent conditions were assumed in loss determinations.

The starting pool elevation at each site was set at spillway crest, or full pool. The 4-foot diameter conduit was assumed to be operational, in addition to the type and size spillway selected based on site constraints. The PMF was routed through flat pool storage utilizing HEC-1. Results of these reservoir routings for the three drybed sites are shown on Plates D-63 through D-65.

Plate D-65A illustrates the future natural and recommended plan SDF (Probable Maximum Precipitation) discharges and elevation hydrographs on Pleasant Run just below High School Branch. Also shown on this plate is

the rainfall distribution for the SDF. Although shown as hourly values, 30-minute duration rainfall was used to compute the SDF hydrographs. The elevation hydrographs were based on results from HEC-2 water surface data for both future natural and with recommended plan conditions. The rating curves at Mile 3.25 were extrapolated above the Standard Project Flood (SPF), up to the SDF level discharges. As can be seen from Plate D-65A, no adverse impact occurs at the SDF level with the recommended plan in place.

LAND ACQUISITION

Land acquisition in the pool areas are based on flat pool elevations resulting from HEC-1 storage routings for the 2-year through 500-year events. No flowline computations (HEC-2) were made in the pool areas of the reservoirs under project conditions.

The alignment of the centerline for Site "D" required excavation in the pool area to attain a desired flood control pool of elevation 701. Natural storage conditions would put the flood control pool about elevation 708. This would impact on the subdivisions adjacent to the pool area. Therefore, excavation within the pool area was required. Initial intentions are to use part of this excavation for fill at the dam. HEC-1 storage routings used the storage area based on this excavation. Plae D-66 show before and with excavation storage curves for Site "D."

Minimum channel capacities and maximum conduit releases at spillway crest are given in Table D-15. On Pleasant Run, this minimum capacity is above the reach requiring 100-year degree of protection. No channel work is justifiable on East Fork, High School Branch, or G. M. Ditch.

TABLE D-15

PEAK RESERVOIR OUTFLOW
AND CHANNEL CAPACITY DATA

Stream/Location	Applicable Dry Bed Reservoir	Maximum Outflow (cfs)	Minimum Channel Capacity (cfs)
Pleasant Run at John Gray Road, Mile 5.60	Site "D"	350	800
East Fork below Resor Road, Mile 0.75	Site "C"	365	900
High School Branch at Mile 0.50 near Right Bank apartment complex	Site "A"	300	500

Table D-15 indicates minimum maintenance would be required to maintain the above channel capacities on Pleasant Run and East Fork. However, regular maintenance will be required on High School Branch.

OUTLET WORKS

Damsite constraints and downstream channel capacities were used as the basis for selecting the capacity, type, and size of the outlet works.

Each damsite was found to require one 4-foot diameter concrete conduit, with maximum outflow at spillway crest tabulated in the discussion on "Land Acquisition." The conduit rating curve for Site "C" is Plate D-67. Intake and impact basins were designed according to Soil Conservation Service (SCS) guidelines. Plate D-68 shows typical isometric views of the intake structure. Plate D-69 shows the general layout of the Impact Basin. Design of the Impact Basins was based on SCS Technical Release No. 49, "Criteria for the Hydraulic Design of Impact Basins associated with full flow in pipe conduits." Plates D-70

through D-72 show the dam profiles for all three drybed reservoirs, with pertinent features and elevations.

An ogee-type spillway structure was selected for all dry bed reservoir sites. Site constraints limited the top of dam elevations to those shown in Table D-14. Spillway crest elevations were designed to the 500-year, 6-hour duration storm, and tested with the 1913 and 1959 winter storms. The spillway crest elevations shown in Table D-10 reflect the 500-year, 6-hour duration storm and those recommended by the Miami Conservancy District (MCD). Table D-16 gives the design depth (top of dam less spillway crest and freeboard) required for the SDF, and the spillway widths selected for each damsite. These spillway widths are the same used by MCD in their independent study at Fairfield.

TABLE D-16

SPILLWAY WIDTH
DESIGN DATA

Reservoir Site	Design Depth (Feet)	SDF Peak Inflow (cfs)	Ogee Spillway Width (Feet)
Site "A"	7	4,600	50
Site "C"	14	12,400	50
Site "D"	9	11,300	100

A Waterways Experiment Station (WES) computer program (H1103) was used to compute the rating curves for the spillways. Design criteria contained in EM 1110-2-1603 "Hydraulic Design of Spillways" is incorporated into the WES computer program. The rating curves generated by H1103 were used in HEC-1 to perform flat pool storage routings of the SDF. The spillway rating curves shown on Plate D-73 are those required to match the design depths and ogee spillway widths shown in Table

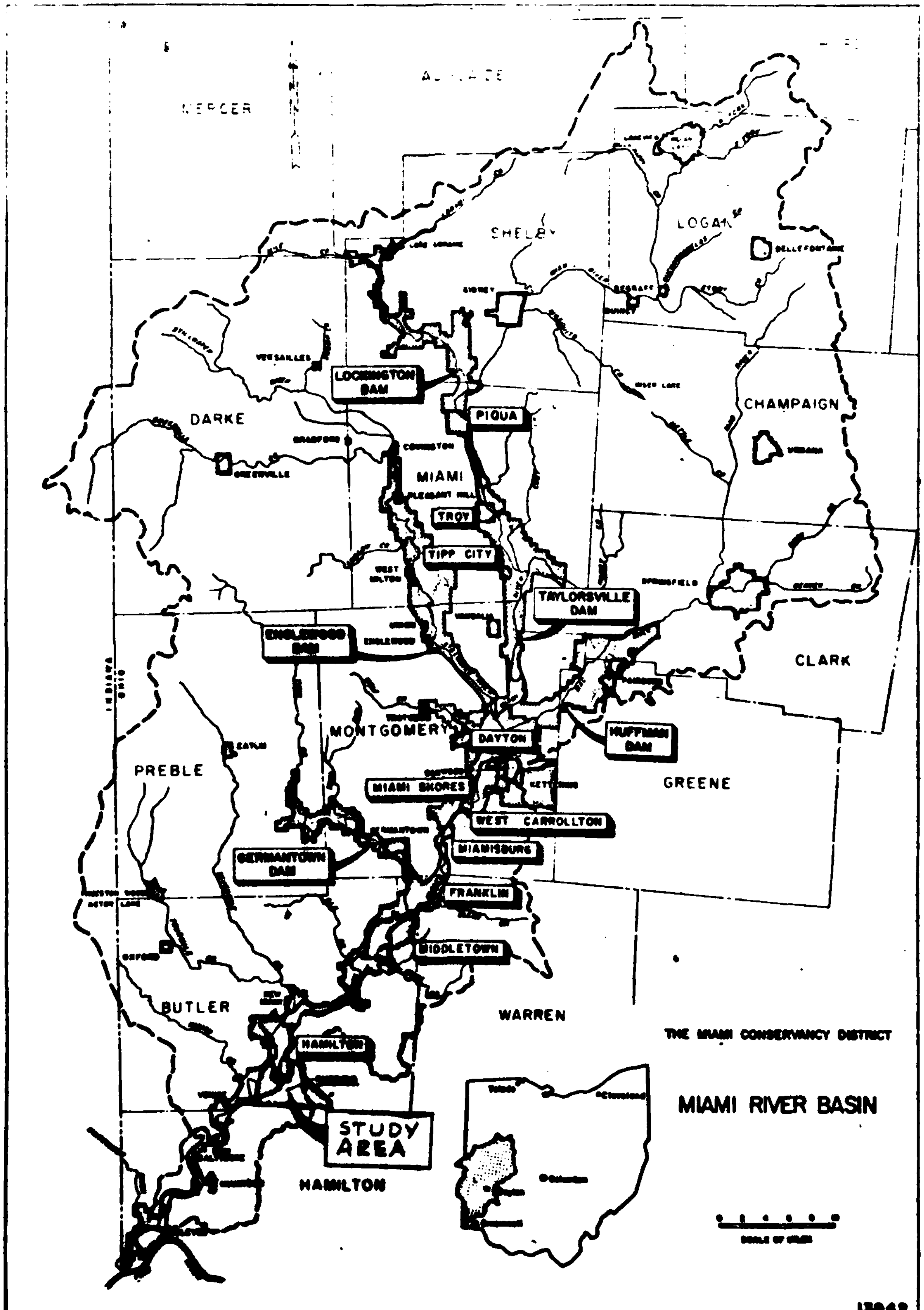
D-16. The difference in rating curves for the 50-foot spillway widths comes from the interpolation in H1103 of Plate 32 (EM 1110-2-1603), with regard to the angle of upstream face of the ogee crest. Further refinement of the data will be undertaken in advanced engineering and design studies to test other design depths and spillway widths.

The riprap required for the retreat channels downstream of the impact basins and ogee spillways will require the minimum size, 12-inch layer, W_{50}, 5 to 11 pounds.

TAILWATER RATING CURVES

Tailwater rating curves at all damsites were computed using field survey sections and the previously discussed HEC-2 computer model. Sites "C" and "D" are located upstream of two secondary road bridges. No work is planned on replacing or modifying these two structures. Consequently, no future changes are anticipated at this time for Sites "C" and "D" rating curves. Site "A" is located upstream of an apartment complex. No future changes are anticipated at this time which would change the tailwater rating at Site "A." Plate D-74 shows the tailwater rating curves for all three drybed reservoir sites.

APPENDIX D
PLATES



MERCER
SHELBY
LOGAN
LOCKINGTON DAM
PIQUA
CHAMPAIGN
DARKE
MIAMI
TROY
TIPP CITY
TAYLORSVILLE DAM
CLARK
MONTGOMERY
DAYTON
HUFFMAN DAM
PREBLE
MIAMI SHORES
GREENE
WEST CARROLLTON
GERMANTOWN DAM
MIAMISBURG
FRANKLIN
MIDDLETOWN
BUTLER
WARREN
HAMILTON
STUDY AREA
HAMILTON
INDIANA
OHIO
THE MIAMI CONSERVANCY DISTRICT
MIAMI RIVER BASIN
13042

PLATE D-1

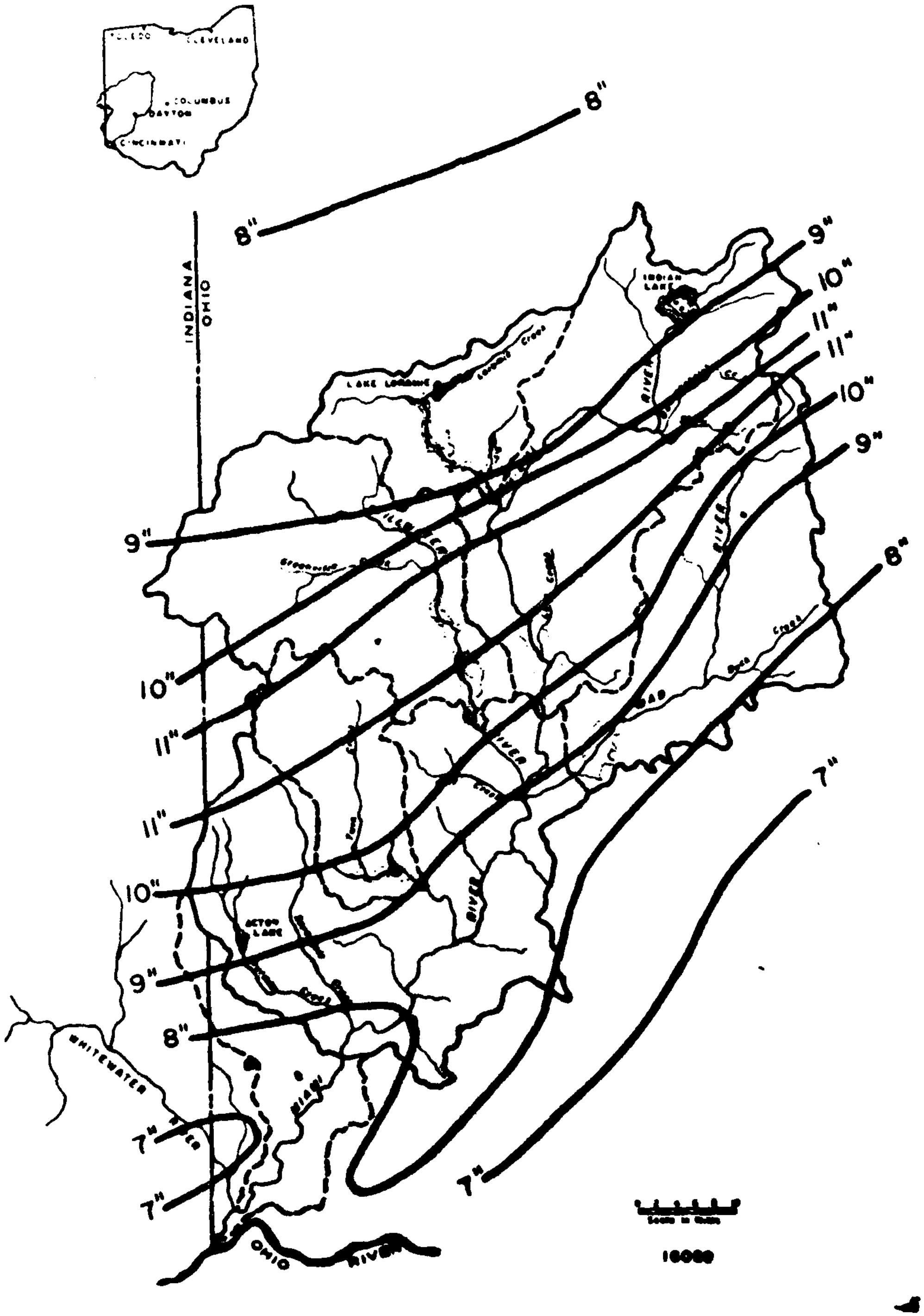


FIGURE 47 RAINFALL ISOHYETALS FOR STORM OF MARCH 23 TO 26, 1913

(From District Technical Report, Part [illegible], p.179)

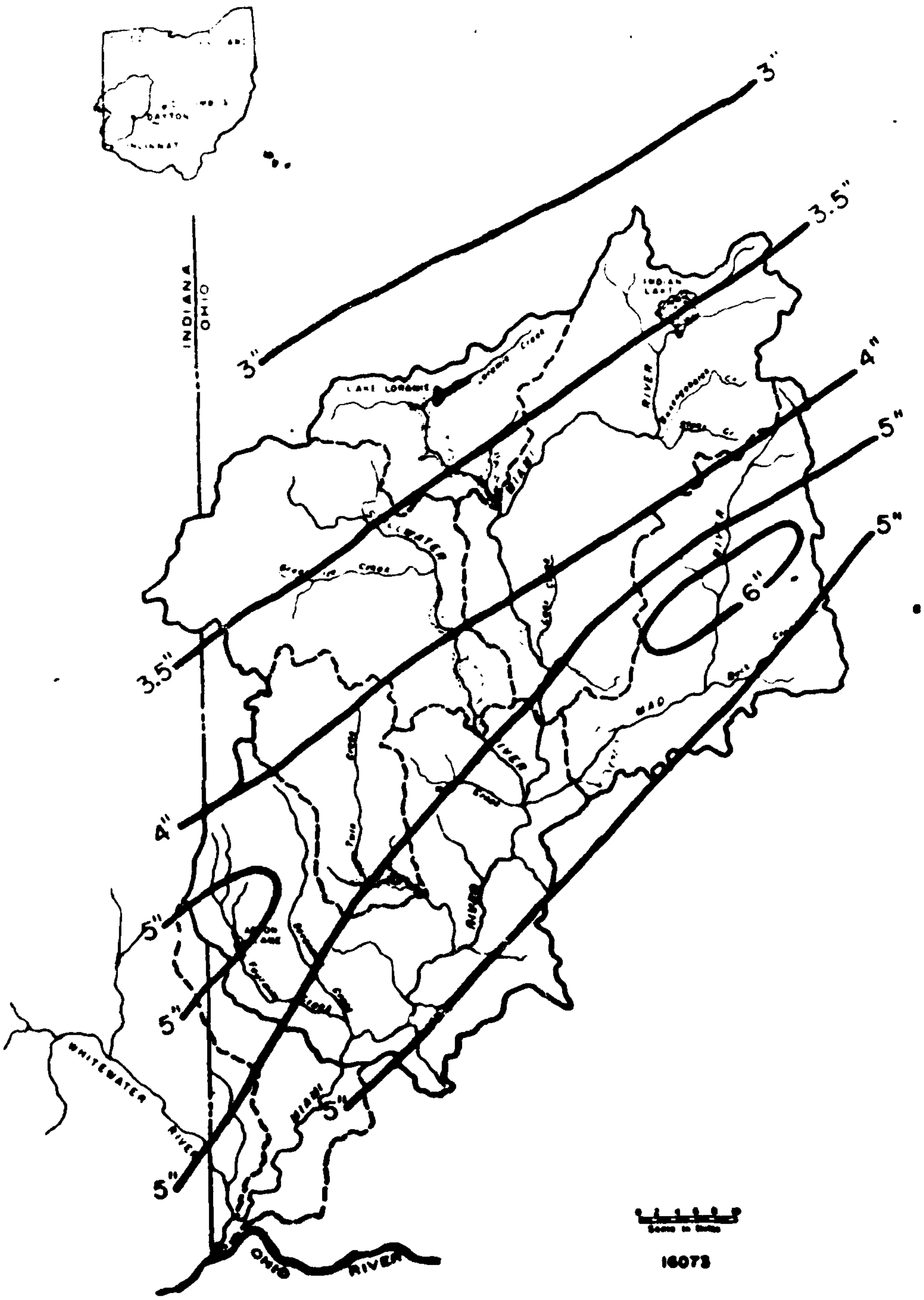
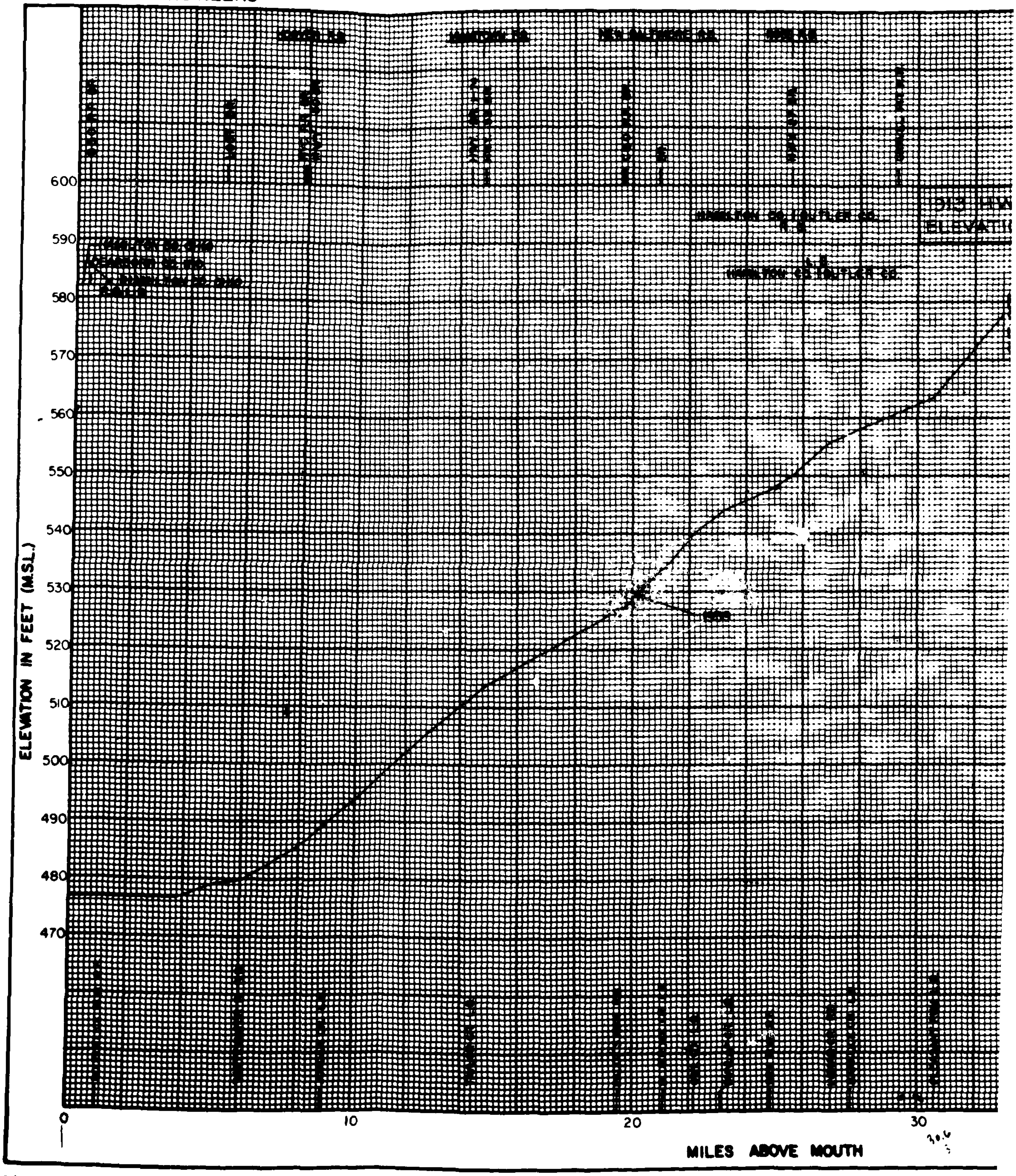
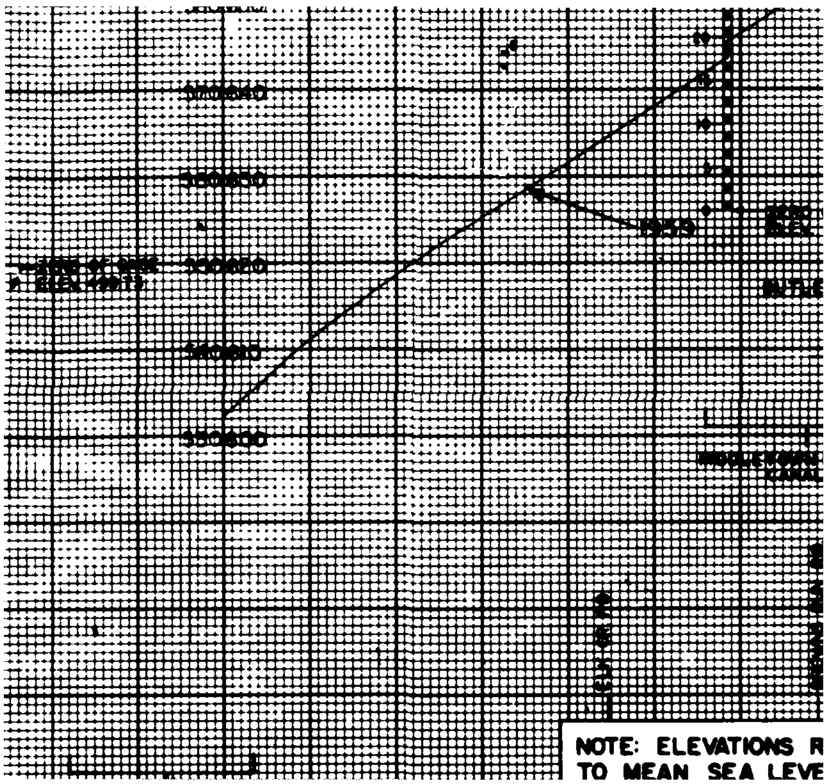
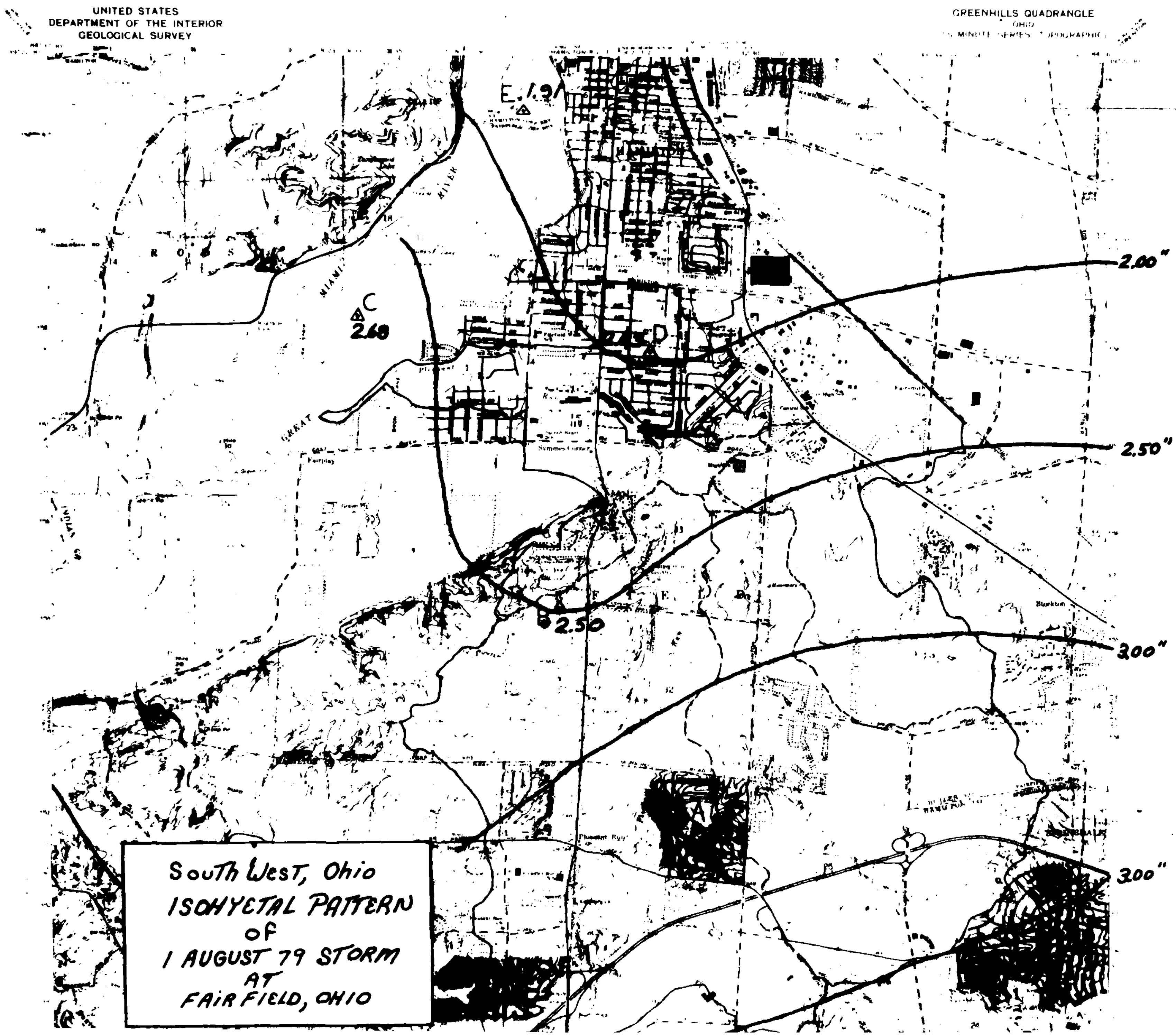


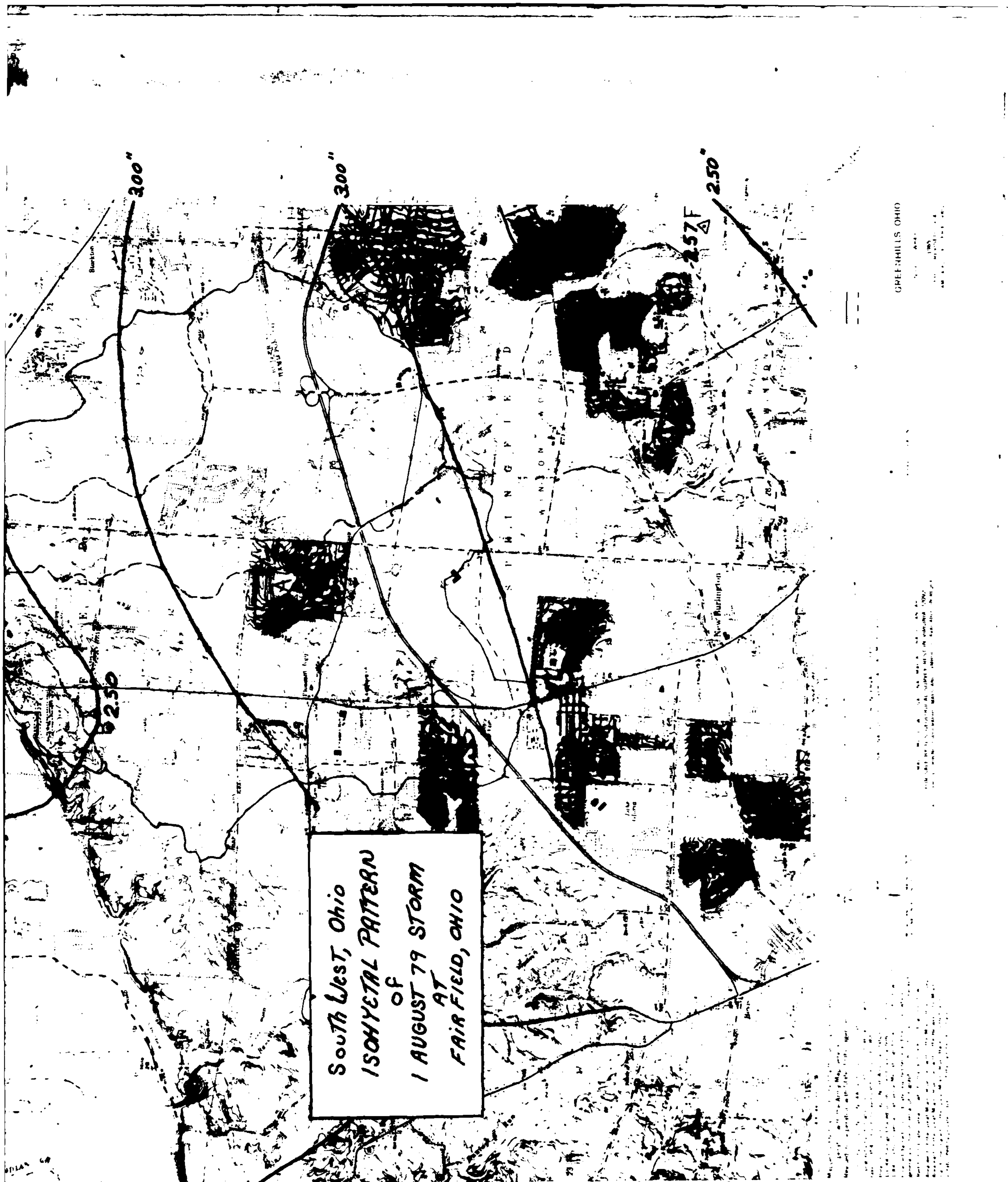
FIGURE 63 RAINFALL ISOHYETALS FOR STORM OF JANUARY 20-21, 1959

CORPS OF ENGINEERS



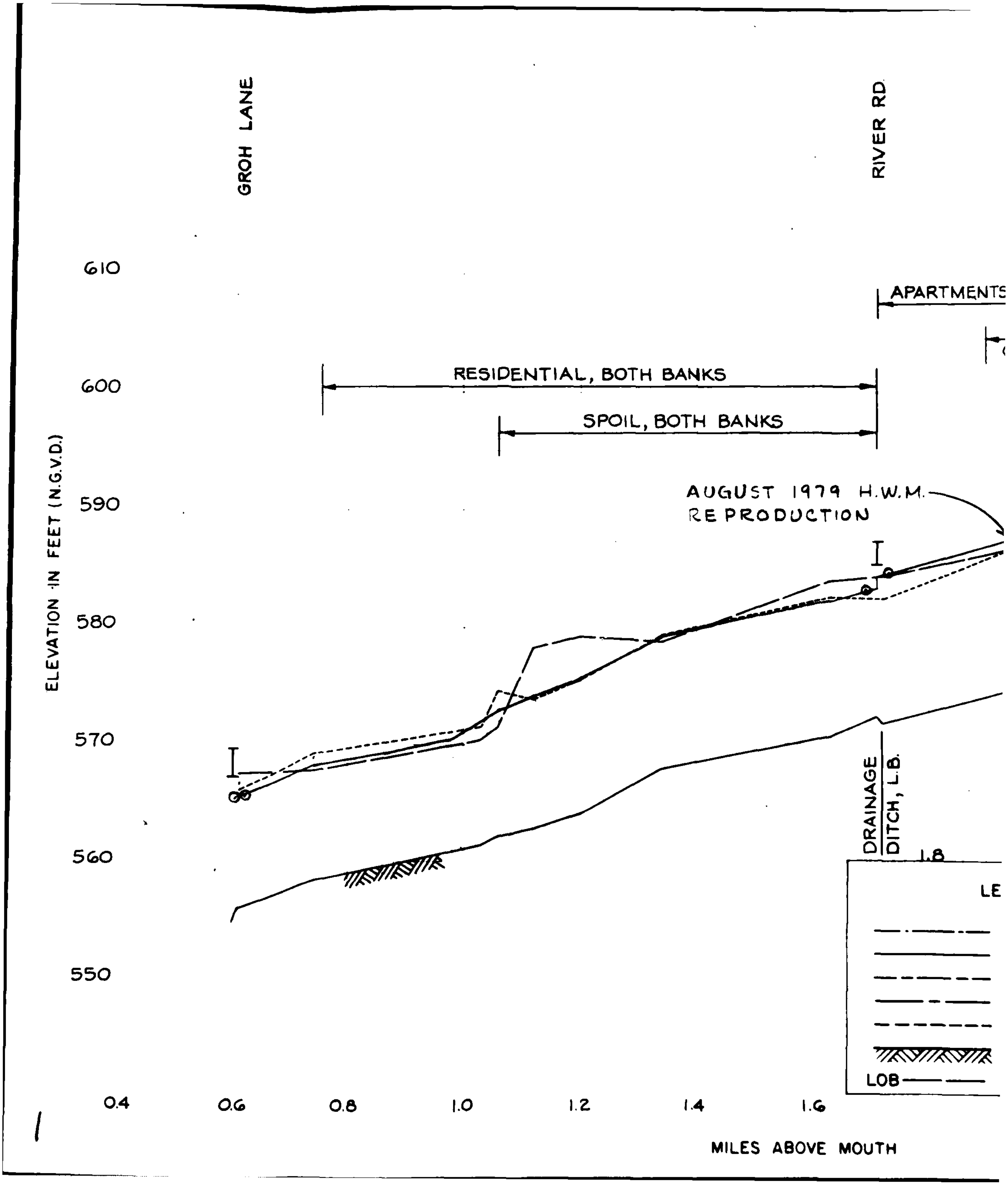

NOTE: ELEVATIONS R
TO MEAN SEA LEVE

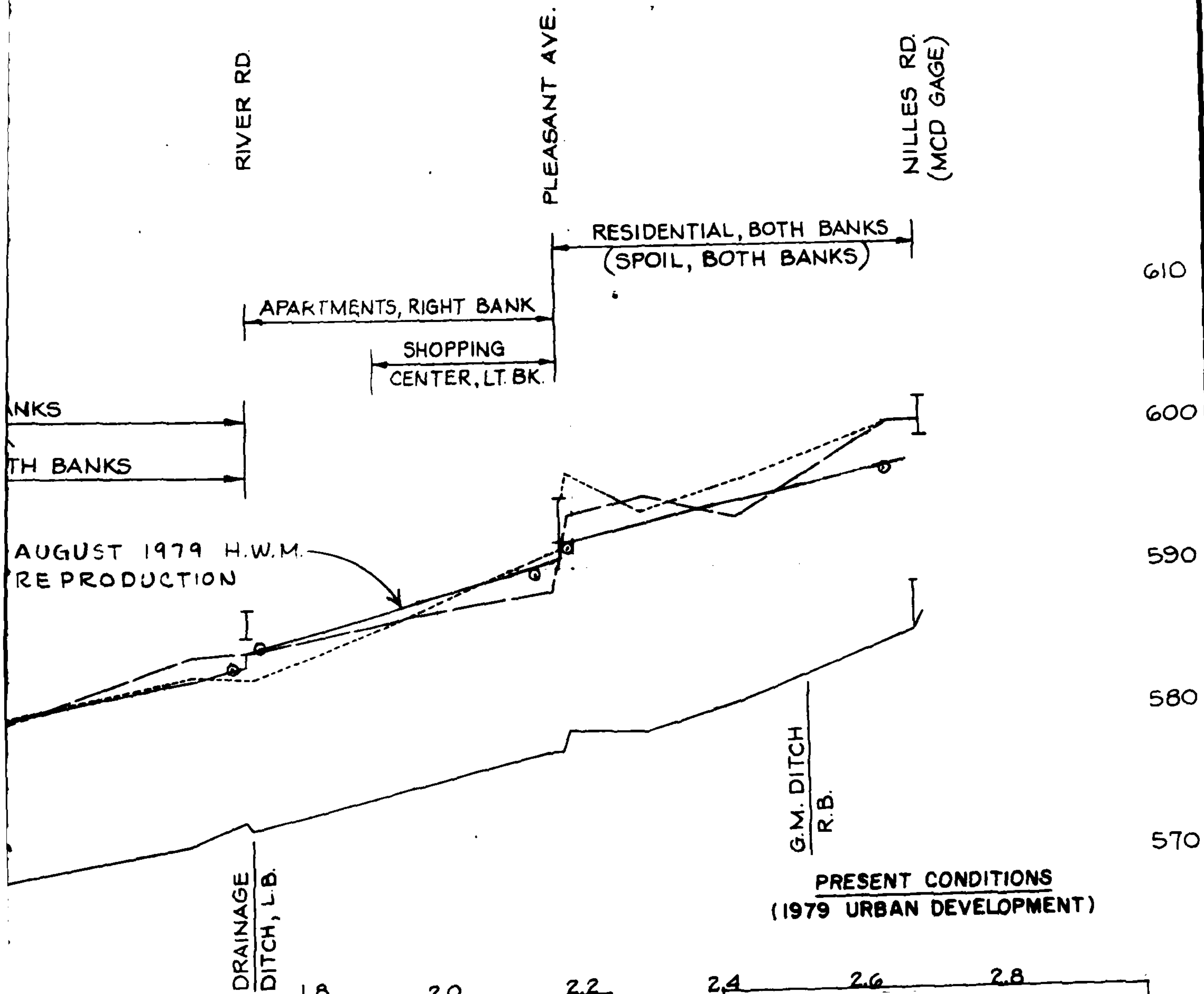

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
GREENHILLS QUADRANGLE
OHIO
E. 1.91
C
2.60
D
2.00"
2.50"
2.50
3.00"
3.00"
GREAT MIAMI RIVER
South West, Ohio
ISOHYETAL PATTERN
of
1 AUGUST 79 STORM
AT
FAIRFIELD, OHIO


South West, Ohio
ISOHYETAL PATTERN
of
1 AUGUST 79 STORM
AT
FAIRFIELD, OHIO
3.00"
3.00"
2.50"
2.50
2.57F
GREENHILLS OHIO

2

PLATE D-5


GROH LANE
RIVER RD
APARTMENTS
RESIDENTIAL, BOTH BANKS
SPOIL, BOTH BANKS
AUGUST 1979 H.W.M. REPRODUCTION
DRAINAGE DITCH, L.B.
ELEVATION IN FEET (N.G.V.D.)
610
600
590
580
570
560
550
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
MILES ABOVE MOUTH
LOB
1



PRESENT CONDITIONS
(1979 URBAN DEVELOPMENT)

LEGEND

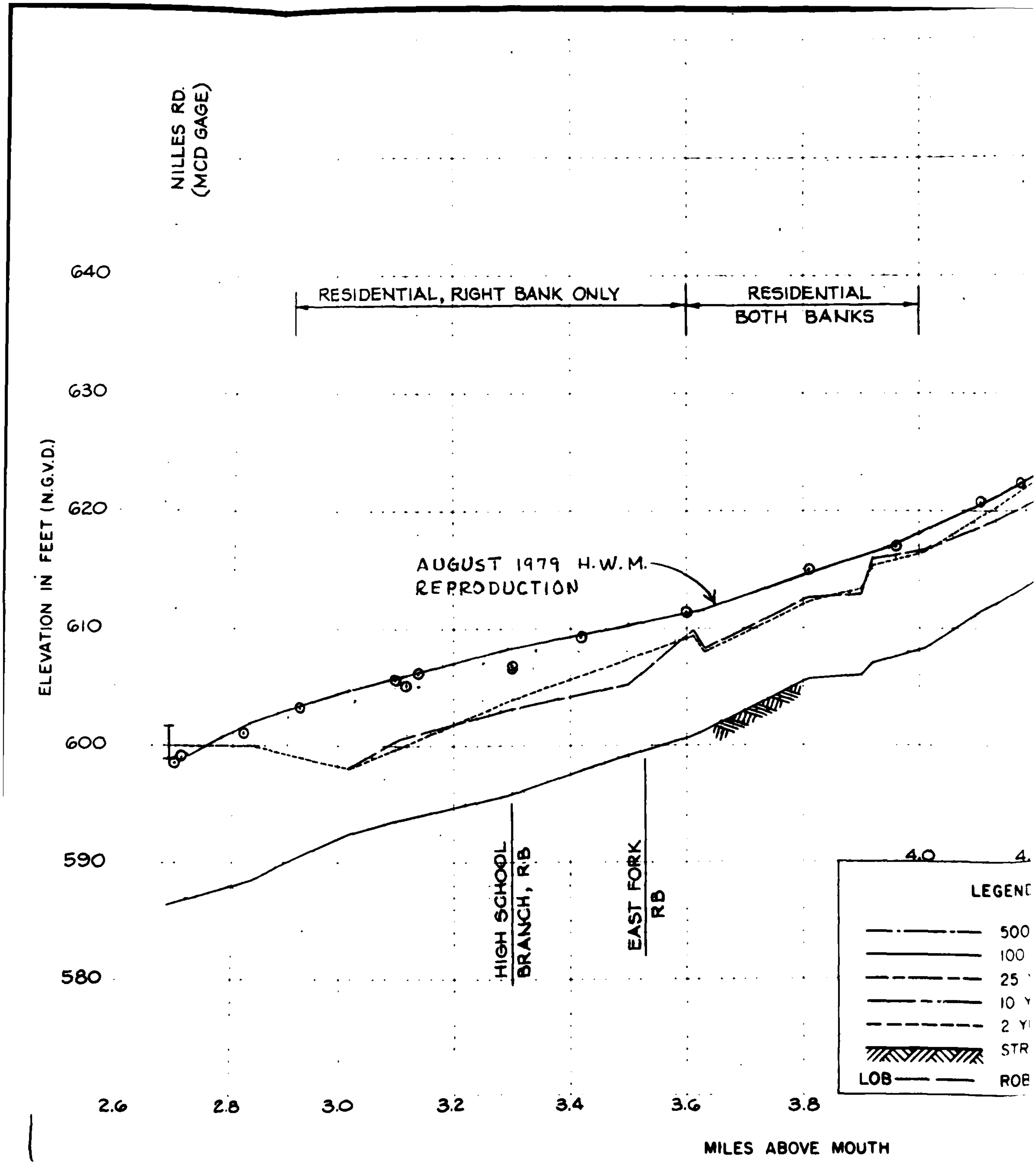
—·—·—	500 YEAR FLOOD
———	100 YEAR FLOOD
— — —	25 YEAR FLOOD
—— —	10 YEAR FLOOD
- - - -	2 YEAR FLOOD
▨	STREAM BED
LOB ———	ROB -------

GREAT MIAMI RIVER BASIN
PLEASANT RUN
FAIRFIELD, OHIO
LOCAL FLOOD PROTECTION PROJECT
NATURAL CONDITION PROFILES
U.S. ARMY ENGINEER DISTRICT
ORLED-H MARCH 1980

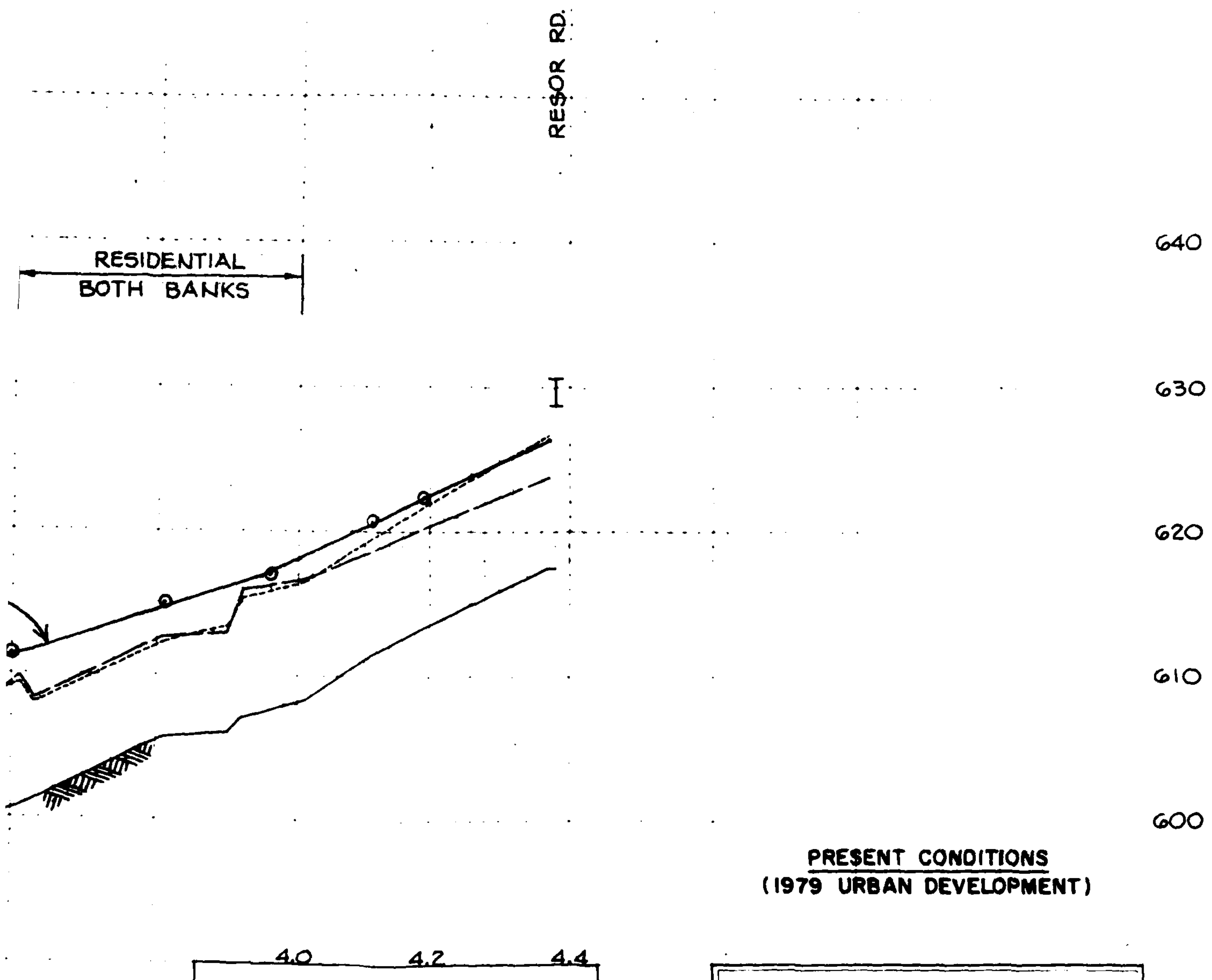
SH 1 OF 3

2

PLATE D-



NILLES RD.
(MCD GAGE)
RESIDENTIAL, RIGHT BANK ONLY
RESIDENTIAL
BOTH BANKS
640
630
620
610
600
590
580
ELEVATION IN FEET (N.G.V.D.)
AUGUST 1979 H.W.M.
REPRODUCTION
HIGH SCHOOL
BRANCH, R.B
EAST FORK
RB
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
MILES ABOVE MOUTH
LOB



PRESENT CONDITIONS
(1979 URBAN DEVELOPMENT)

LEGEND

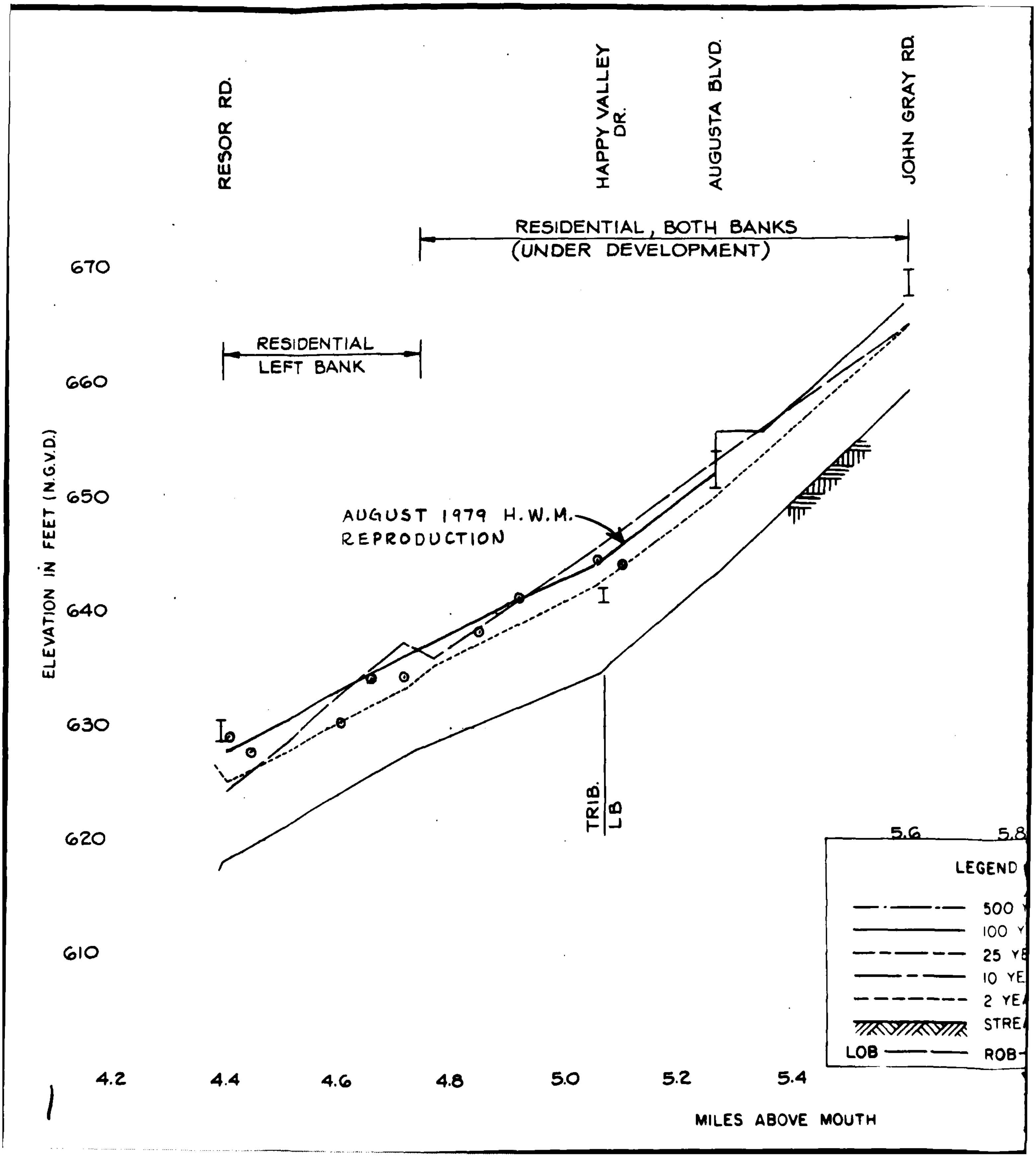
—·—·—·—	500 YEAR FLOOD
————	100 YEAR FLOOD
– – – – –	25 YEAR FLOOD
—— – ——	10 YEAR FLOOD
- - - - - -	2 YEAR FLOOD
//////	STREAM BED
LOB —— ——	ROB - - - - - - - -

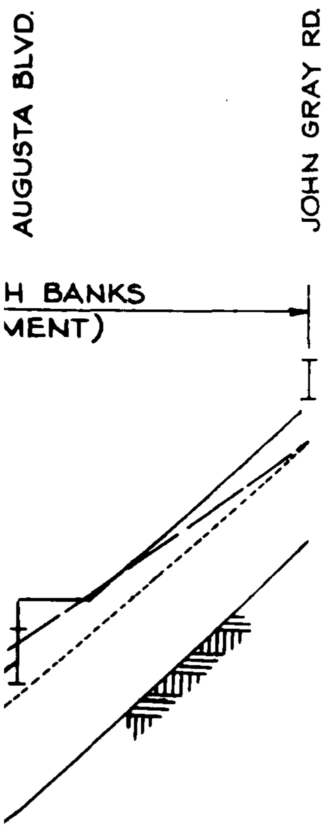
GREAT MIAMI RIVER BASIN
PLEASANT RUN
FAIRFIELD, OHIO
LOCAL FLOOD PROTECTION PROJECT
NATURAL CONDITION PROFILES
U.S. ARMY ENGINEER DISTRICT
ORLED-H MARCH 1980

SH. 2 OF 3

2

PLATE D-7


RESOR RD.
HAPPY VALLEY DR.
AUGUSTA BLVD.
JOHN GRAY RD.
RESIDENTIAL, BOTH BANKS
(UNDER DEVELOPMENT)
RESIDENTIAL
LEFT BANK
AUGUST 1979 H.W.M.
REPRODUCTION
TRIB.
LB
ELEVATION IN FEET (N.G.V.D.)
670
660
650
640
630
620
610
4.2
4.4
4.6
4.8
5.0
5.2
5.4
5.6
5.8
MILES ABOVE MOUTH
LEGEND
500 Y
100 Y
25 YE
10 YE
2 YE
STRE
LOB
ROB



PRESENT CONDITIONS
(1979 URBAN DEVELOPMENT)

5.6 5.8 6.0

LEGEND

—·—·—	500 YEAR FLOOD
———	100 YEAR FLOOD
— — —	25 YEAR FLOOD
——— —	10 YEAR FLOOD
- - - -	2 YEAR FLOOD
//////	STREAM BED
LOB ———	ROB - - - - - -

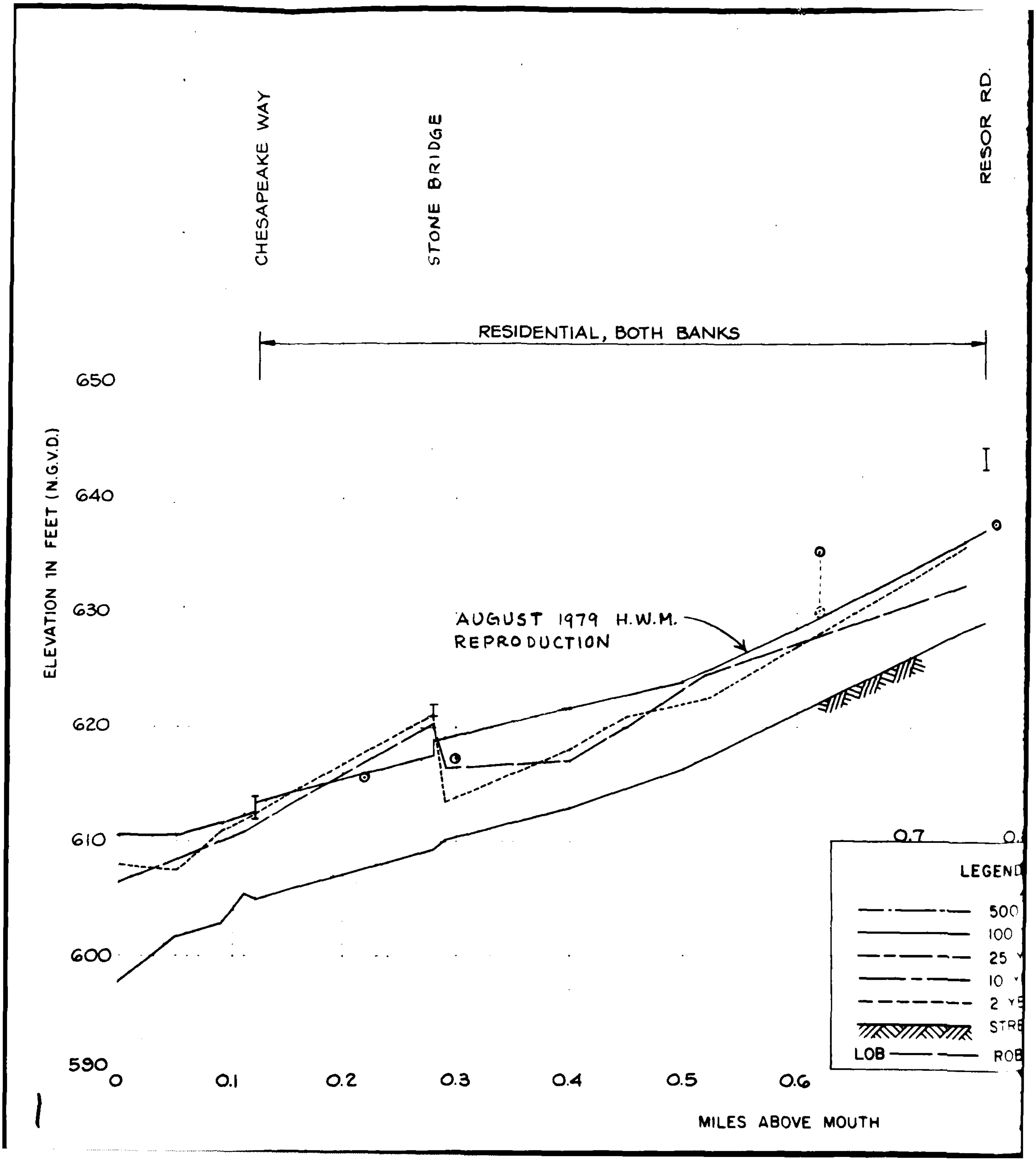
GREAT MIAMI RIVER BASIN
PLEASANT RUN
FAIRFIELD, OHIO
LOCAL FLOOD PROTECTION PROJECT
NATURAL CONDITION PROFILES
U.S. ARMY ENGINEER DISTRICT
ORLED-H MARCH 1980

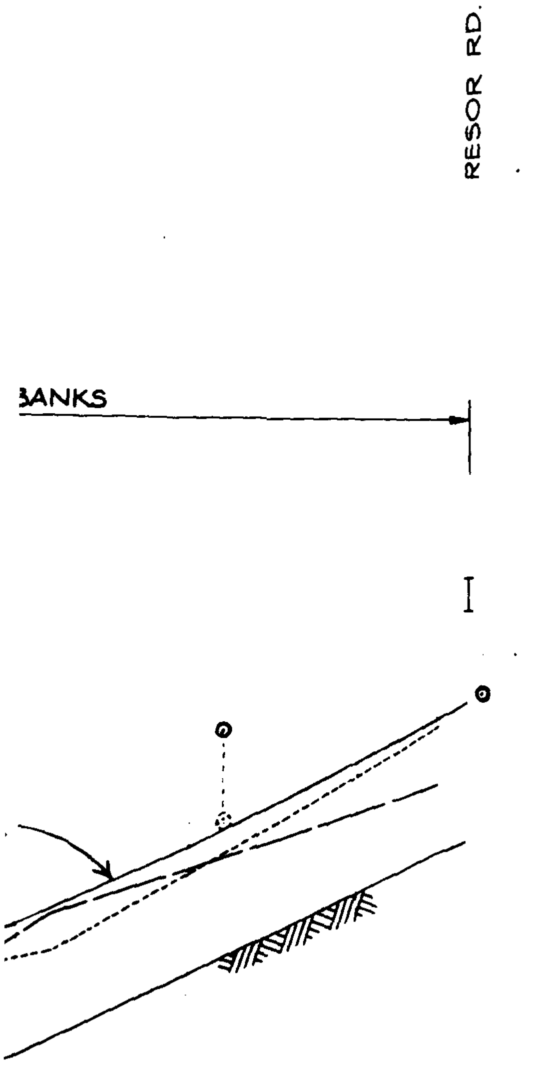
5.4

SH. 3 OF 3

.ES ABOVE MOUTH

2


CHESAPEAKE WAY
STONE BRIDGE
RESOR RD.
RESIDENTIAL, BOTH BANKS
650
640
630
620
610
600
590
ELEVATION IN FEET (N.G.V.D.)
AUGUST 1979 H.W.M. REPRODUCTION
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
MILES ABOVE MOUTH
LEGEND
500
100
25
10
2
LOB
ROB



0.7 0.8

LEGEND

—·—·—	500 YEAR FLOOD
———	100 YEAR FLOOD
— — —	25 YEAR FLOOD
—— - ——	10 YEAR FLOOD
- - - -	2 YEAR FLOOD
▨▨▨	STREAM BED
LOB — —	ROB - - - - -

.5 0.6

MILES ABOVE MOUTH

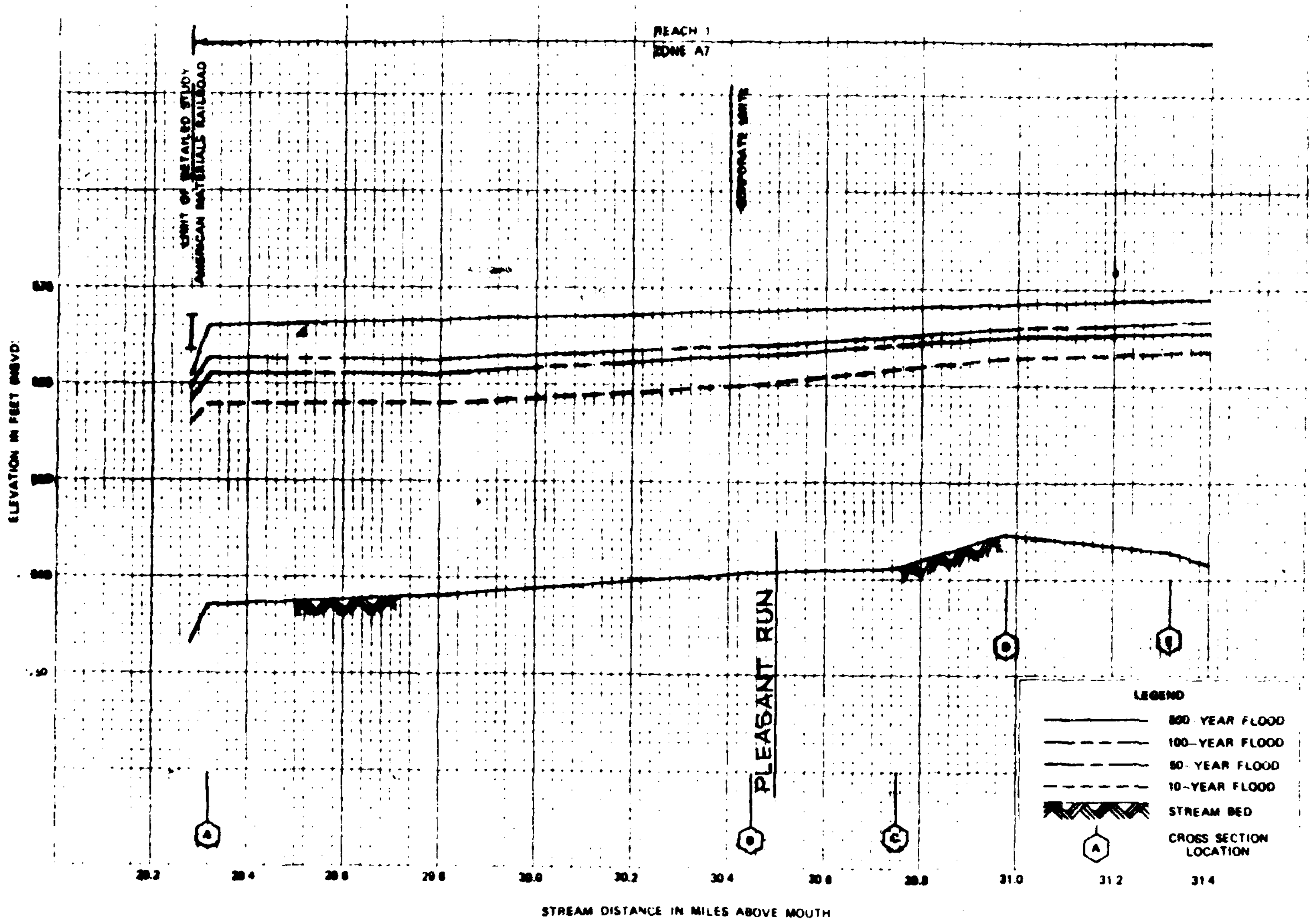
PRESENT CONDITIONS
(1979 URBAN DEVELOPMENT)

GREAT MIAMI RIVER BASIN
EAST FORK PLEASANT RUN
FAIRFIELD, OHIO
LOCAL FLOOD PROTECTION PROJECT
NATURAL CONDITION PROFILES
U.S. ARMY ENGINEER DISTRICT
ORLED-H MARCH 1980

SH. 1 OF 1

2

PLATE D-9



FLOOD PROFILES

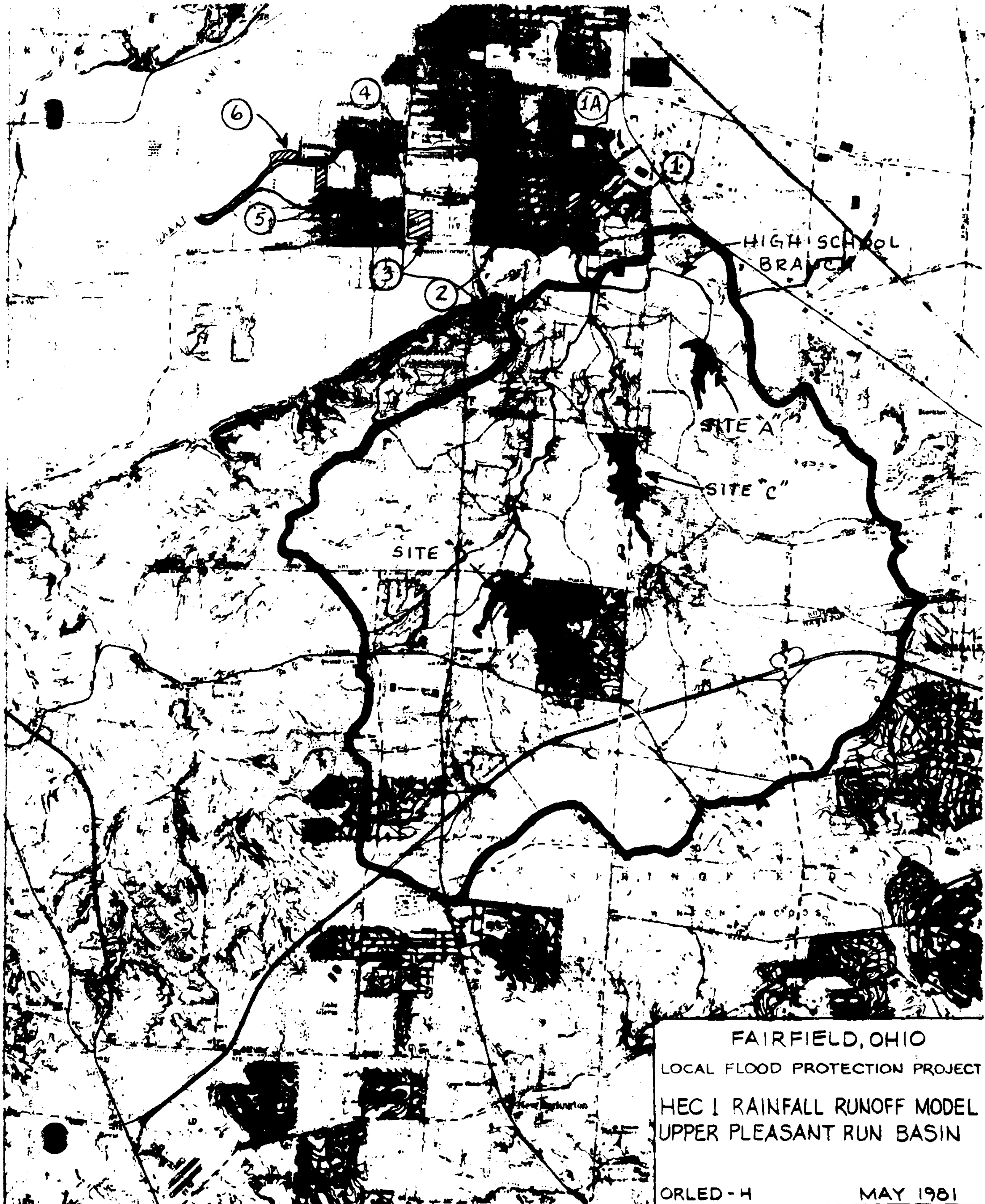
GREAT MIAMI RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

COUNTY OF BUTLER, OH
(UNINCORPORATED AREAS)

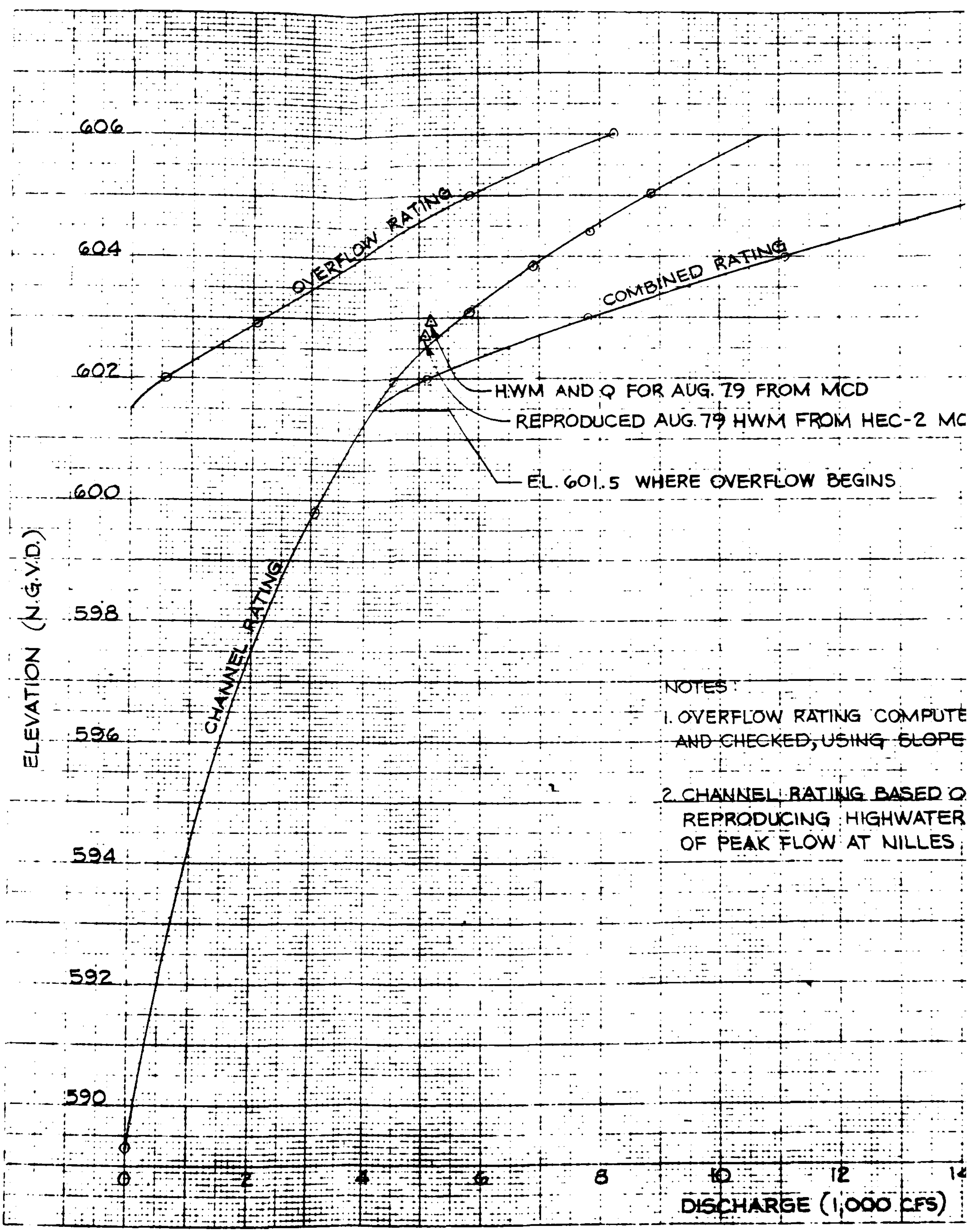
01P

PLATE D-10



FAIRFIELD, OHIO
LOCAL FLOOD PROTECTION PROJECT
HEC 1 RAINFALL RUNOFF MODEL
UPPER PLEASANT RUN BASIN
ORLED - H
MAY 1981

PLATE D-11



OVERFLOW RATING
COMBINED RATING
CHANNEL RATING
HWM AND Q FOR AUG. 79 FROM MCD
REPRODUCED AUG. 79 HWM FROM HEC-2 MC
EL. 601.5 WHERE OVERFLOW BEGINS
NOTES:
1. OVERFLOW RATING COMPUTE
AND CHECKED, USING SLOPE
2. CHANNEL RATING BASED O
REPRODUCING HIGHWATER
OF PEAK FLOW AT NILLES
ELEVATION (N.G.V.D.)
606
604
602
600
598
596
594
592
590
0
2
4
6
8
10
12
DISCHARGE (1,000 CFS)

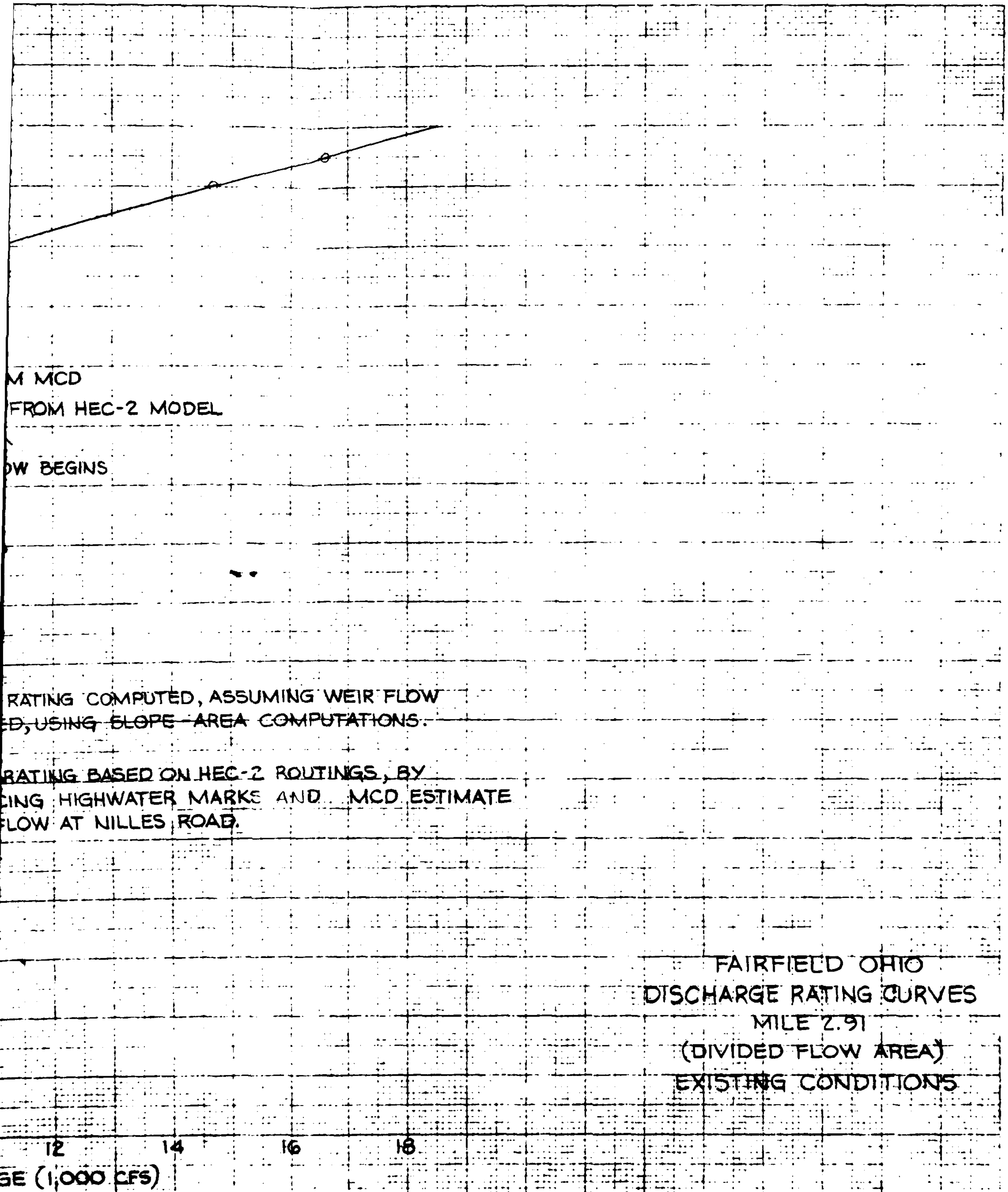

M MCD
FROM HEC-2 MODEL
W BEGINS
RATING COMPUTED, ASSUMING WEIR FLOW
~~ED, USING SLOPE AREA COMPUTATIONS.~~
RATING BASED ON HEC-2 ROUTINGS, BY
CING HIGHWATER MARKS AND MCD ESTIMATE
FLOW AT NILLES ROAD.
FAIRFIELD OHIO
DISCHARGE RATING CURVES
MILE 2.91
(DIVIDED FLOW AREA)
EXISTING CONDITIONS
12
14
16
18
GE (1,000 CFS)

PLATE D-12

2

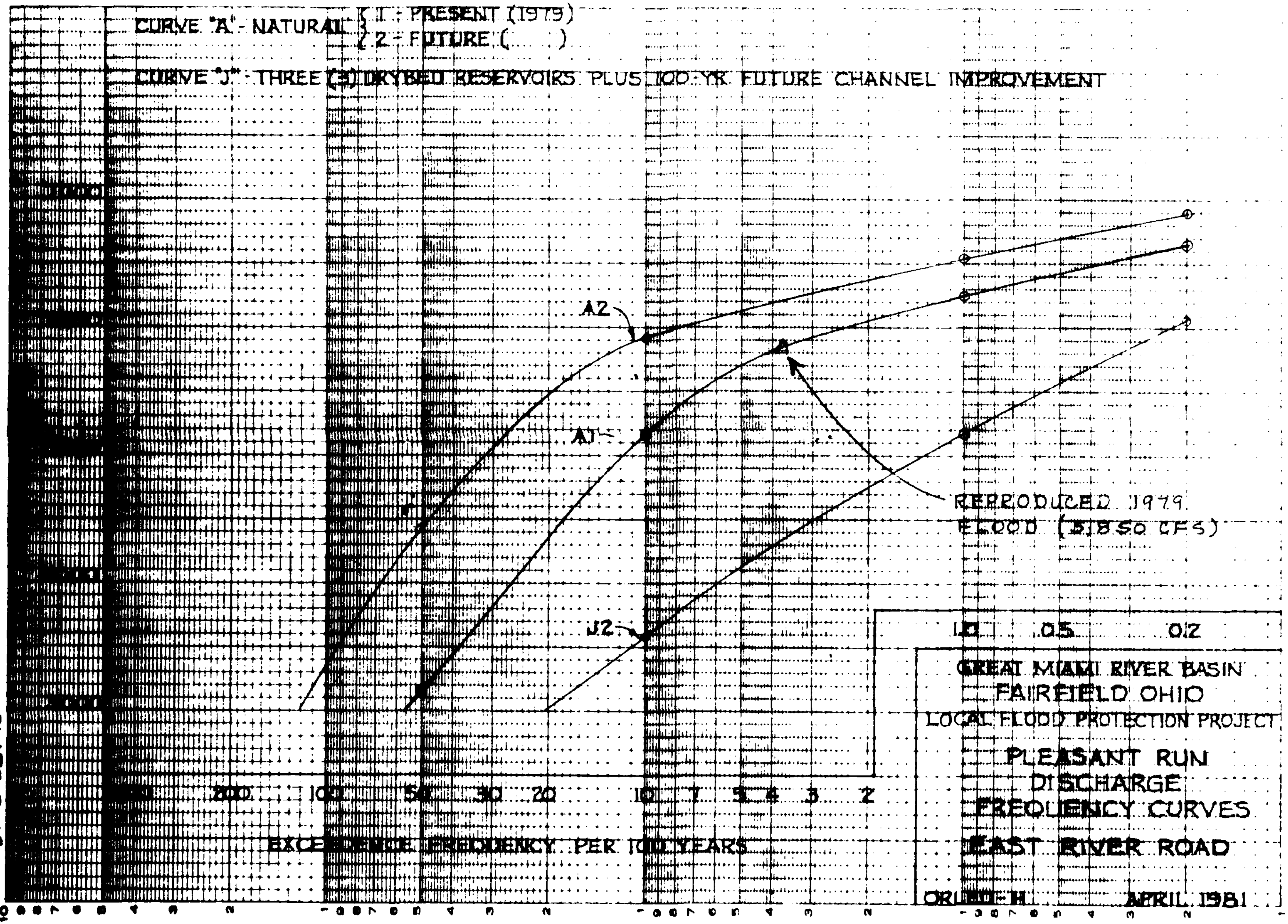
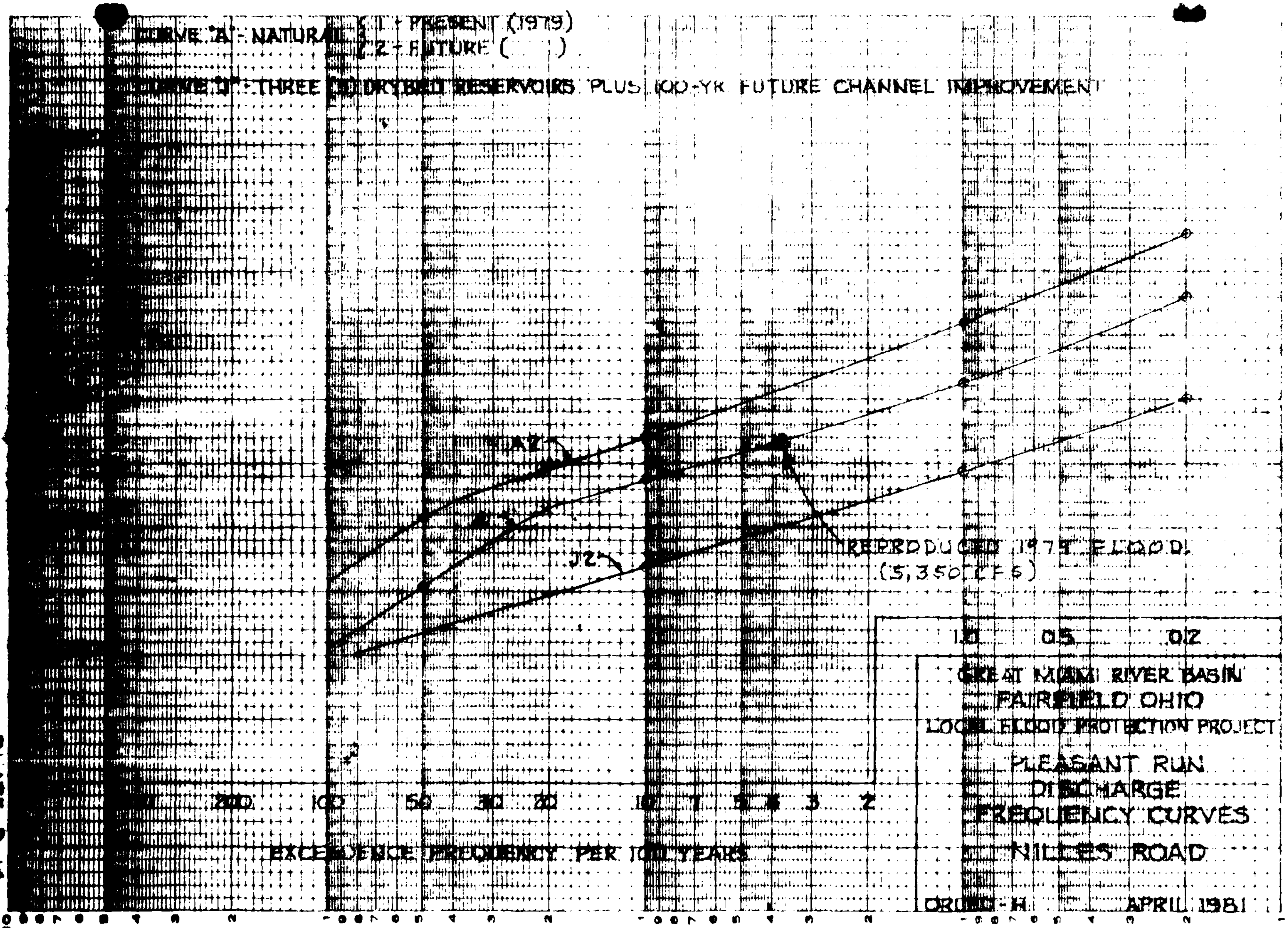

CURVE "A" - NATURAL { 1 - PRESENT (1979) / 2 - FUTURE ( )
CURVE "J" - THREE (3) DRYBED RESERVOIRS PLUS 100-YR FUTURE CHANNEL IMPROVEMENT
A2
A1
J2
REPRODUCED 1979 FLOOD (31850 CFS)
200 100 50 30 20 10 7 5 4 3 2 1.0 0.5 0.2
EXCEEDENCE FREQUENCY PER 100 YEARS
GREAT MIAMI RIVER BASIN
FAIRFIELD OHIO
LOCAL FLOOD PROTECTION PROJECT
PLEASANT RUN
DISCHARGE
FREQUENCY CURVES
EAST RIVER ROAD
ORLRD-H
APRIL 1981
SEMI-LOGARITHMIC
4 CYCLES X 10 DIVISIONS PER INCH
MADE IN U.S.A.

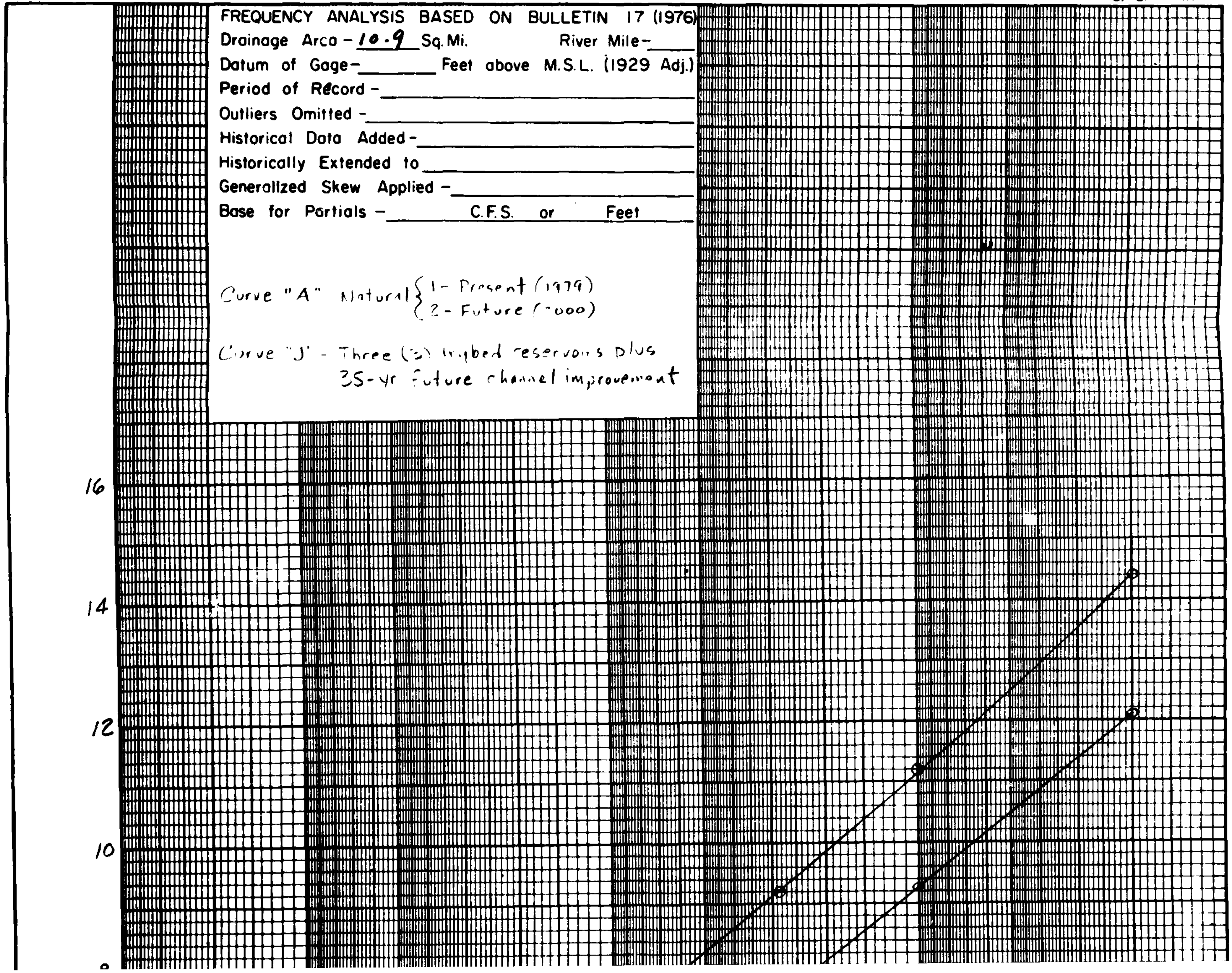
PLATE D-13

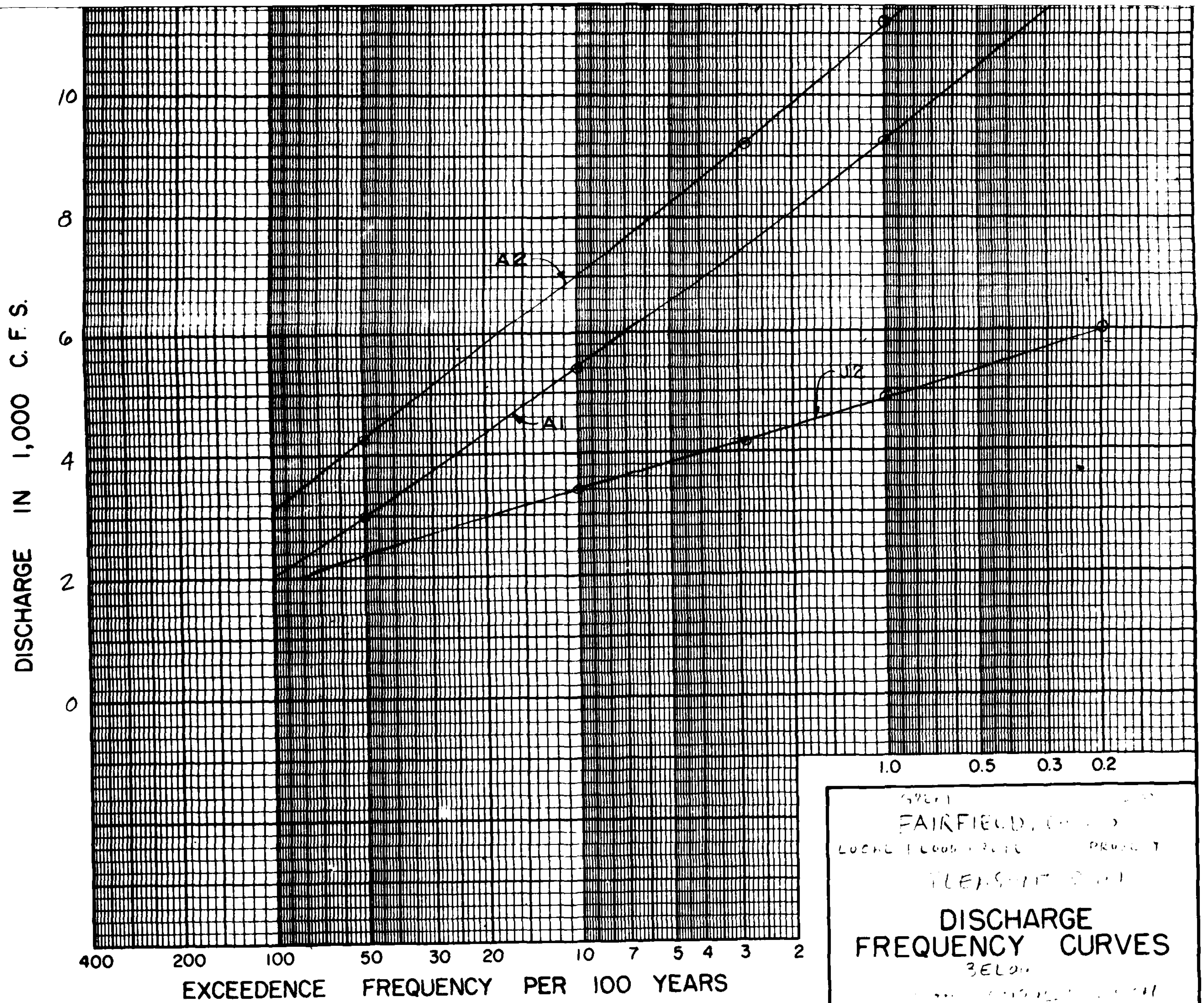


CURVE 'A' - NATURAL
1 - PRESENT (1979)
2 - FUTURE ( )
CURVE 'J' - THREE (3) DRY BED RESERVOIRS PLUS 100-YR FUTURE CHANNEL IMPROVEMENT
A2
J2
REPRODUCED 1979 FLOOD (5,350 CFS)
200
100
50
30
20
10
7
5
4
3
2
1.0
0.5
0.2
EXCEEDENCE FREQUENCY PER 100 YEARS
GREAT MIAMI RIVER BASIN
FAIRFIELD OHIO
LOCAL FLOOD PROTECTION PROJECT
PLEASANT RUN
DISCHARGE
FREQUENCY CURVES
NILLES ROAD
ORDMD-H
APRIL 1981

PLATE D-14

CORPS OF ENGINEERS U. S. ARMY





FAIRFIELD,

DISCHARGE FREQUENCY CURVES

BELOW

ORLED-H

APRIL 19

Approved by ___ ___ Transmitted to ______ on ______ 1981

PLATE D-15

2

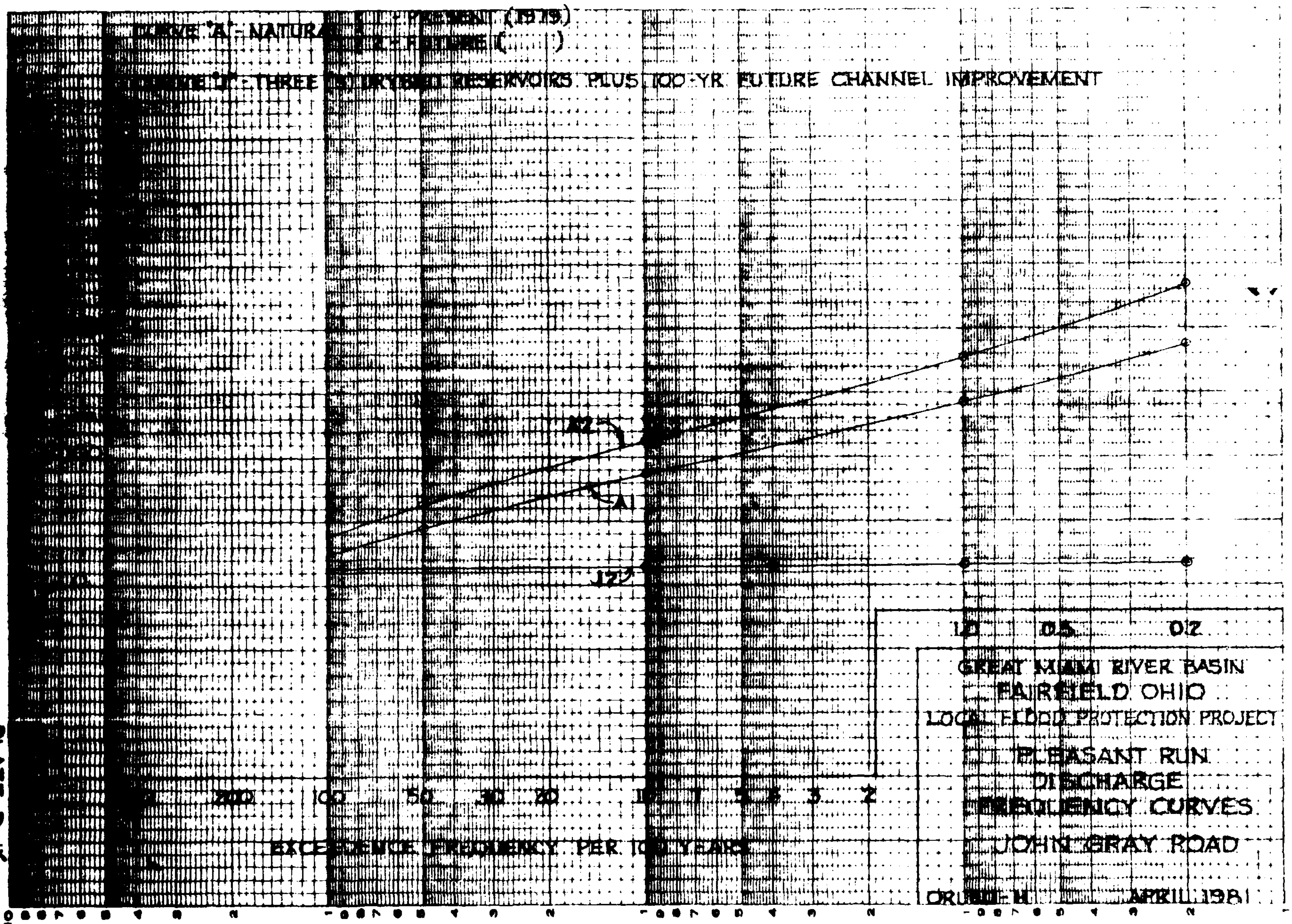

PRESENT (1979)
FUTURE ( )
CURVE 'B' - THREE DRYBED RESERVOIRS PLUS 100-YR FUTURE CHANNEL IMPROVEMENT
A2
A1
1.0
0.5
0.2
GREAT MIAMI RIVER BASIN
FAIRFIELD OHIO
LOCAL FLOOD PROTECTION PROJECT
PLEASANT RUN
DISCHARGE
FREQUENCY CURVES
JOHN GRAY ROAD
APRIL 1981
200
100
50
30
20
10
7
5
3
2
EXCEEDENCE FREQUENCY PER 100 YEARS

PLATE D-16

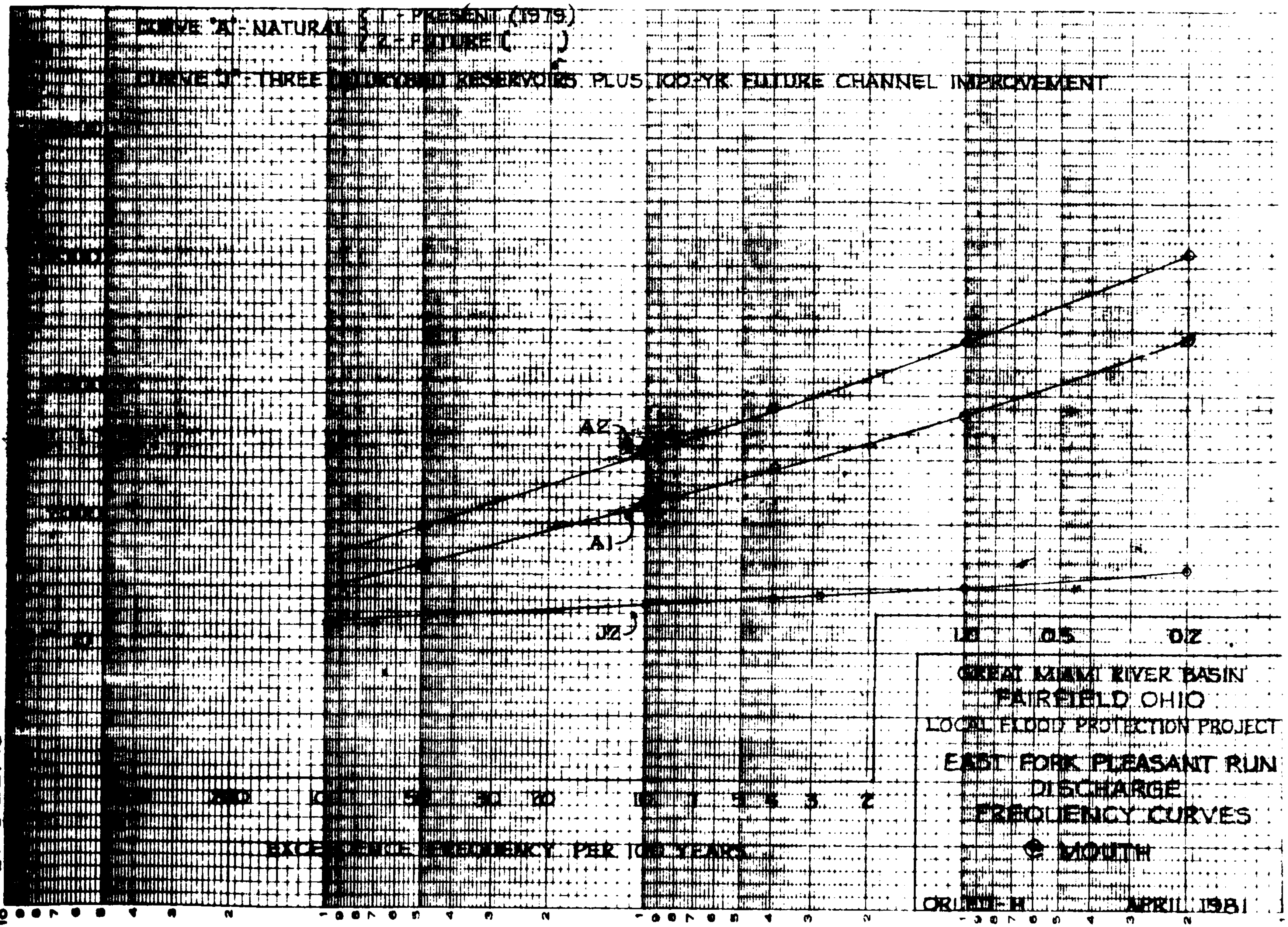
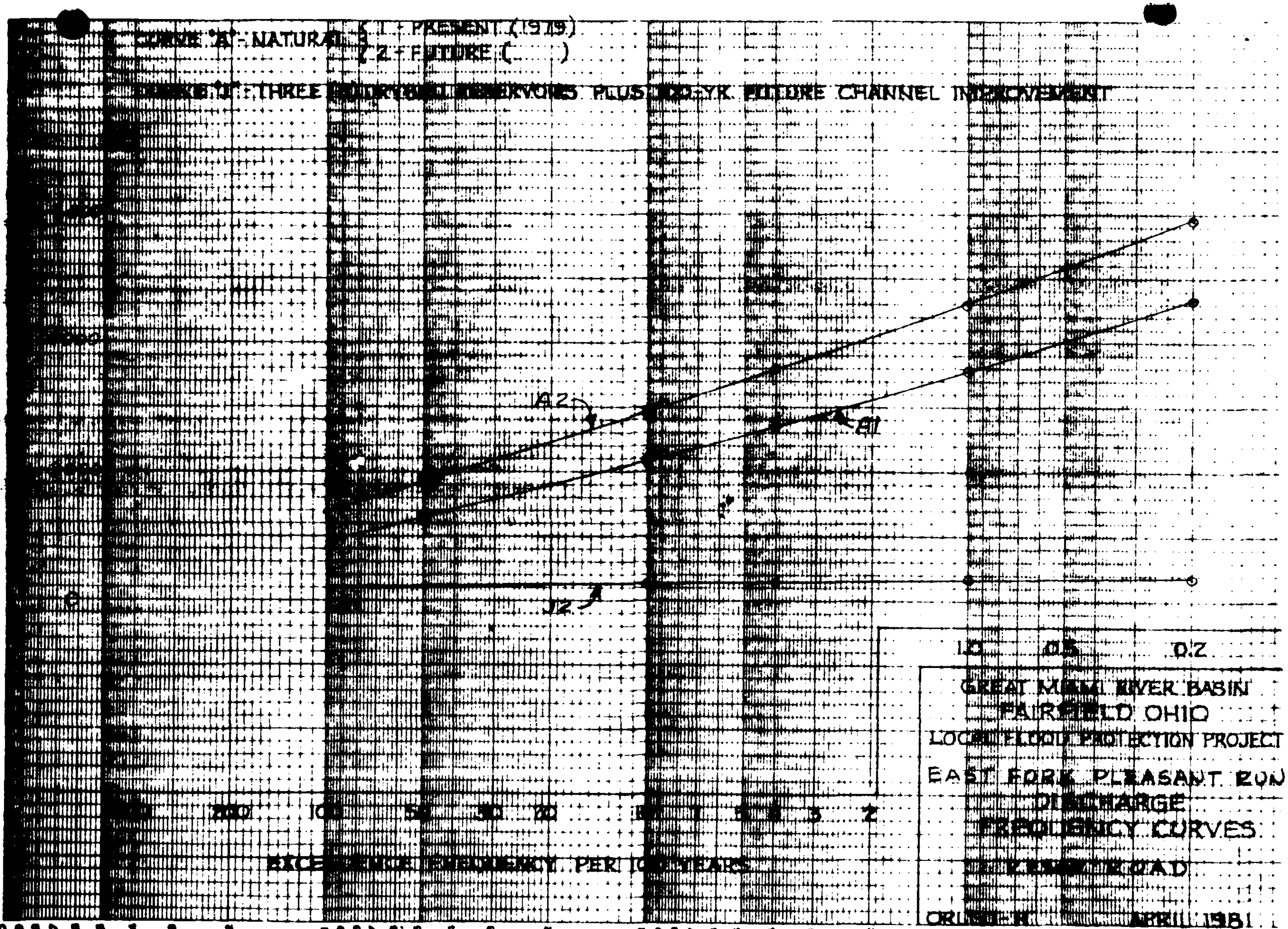

CURVE "A" - NATURAL 1 - PRESENT (1979)
2 - FUTURE ( )
CURVE "J" - THREE RESERVOIRS PLUS 100-YR. FUTURE CHANNEL IMPROVEMENT
A2
A1
J2
500
200
100
50
30
20
10
7
5
3
2
1.0
0.5
0.2
EXCEEDENCE FREQUENCY PER 100 YEARS
GREAT MIAMI RIVER BASIN
FAIRFIELD OHIO
LOCAL FLOOD PROTECTION PROJECT
EAST FORK PLEASANT RUN
DISCHARGE
FREQUENCY CURVES
@ MOUTH
APRIL 1981
SEMI-LOGARITHMIC
4 CYCLES X 10 DIVISIONS PER INCH
MADE IN U.S.A.

PLATE D-17



CURVE 'A' - NATURAL { 1 - PRESENT (1979)
2 - FUTURE ( )
CURVE 'J' - THREE DRY RESERVOIRS PLUS 100-YR FUTURE CHANNEL IMPROVEMENT
A2
A1
J2
EXCEEDENCE FREQUENCY PER 100 YEARS
200 100 50 30 20 10 5 3 2 1.0 0.5 0.2
GREAT MIAMI RIVER BASIN
FAIRFIELD OHIO
LOCAL FLOOD PROTECTION PROJECT
EAST FORK PLEASANT RUN
DISCHARGE
FREQUENCY CURVES
APRIL 1981

PLATE D-18

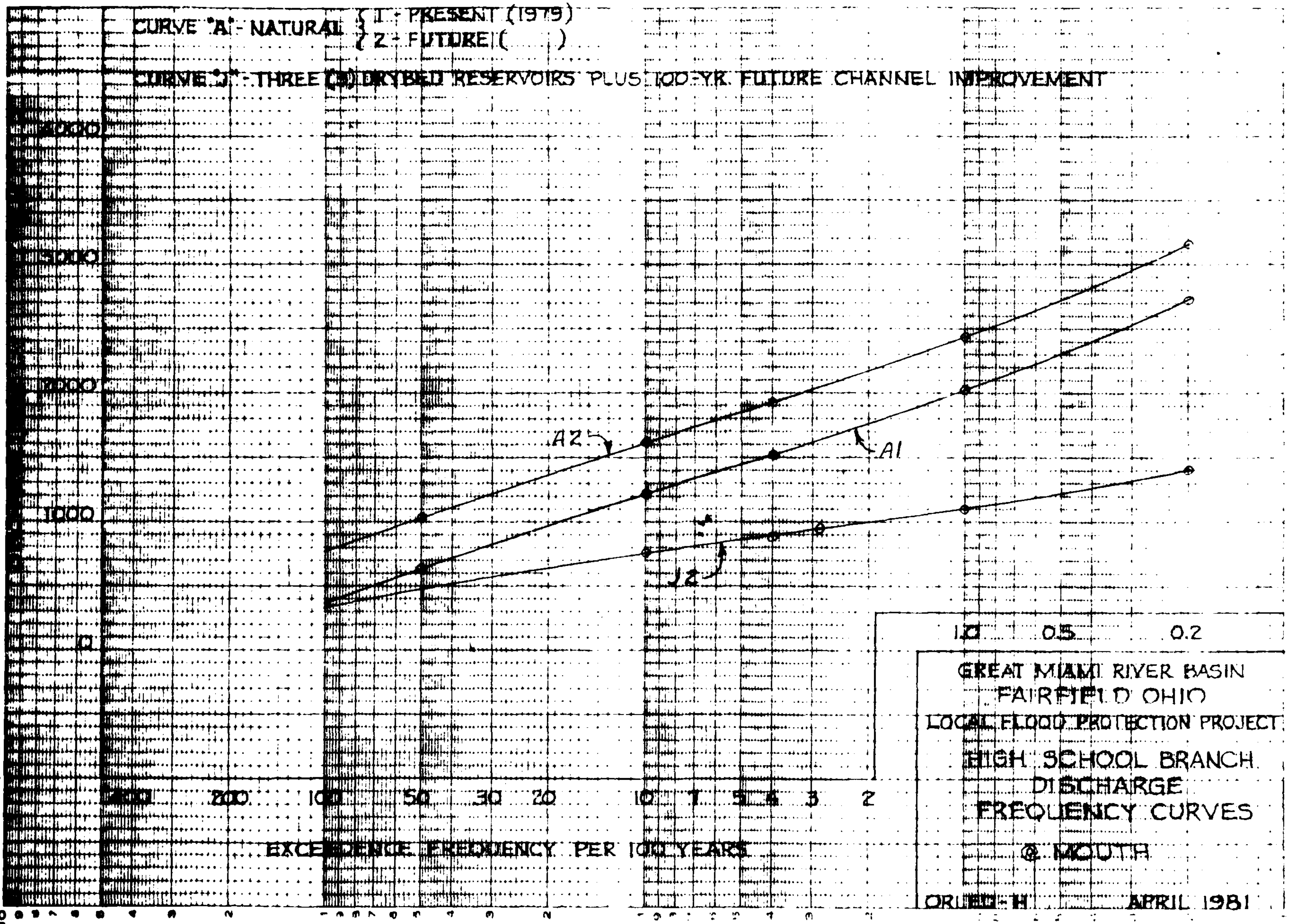
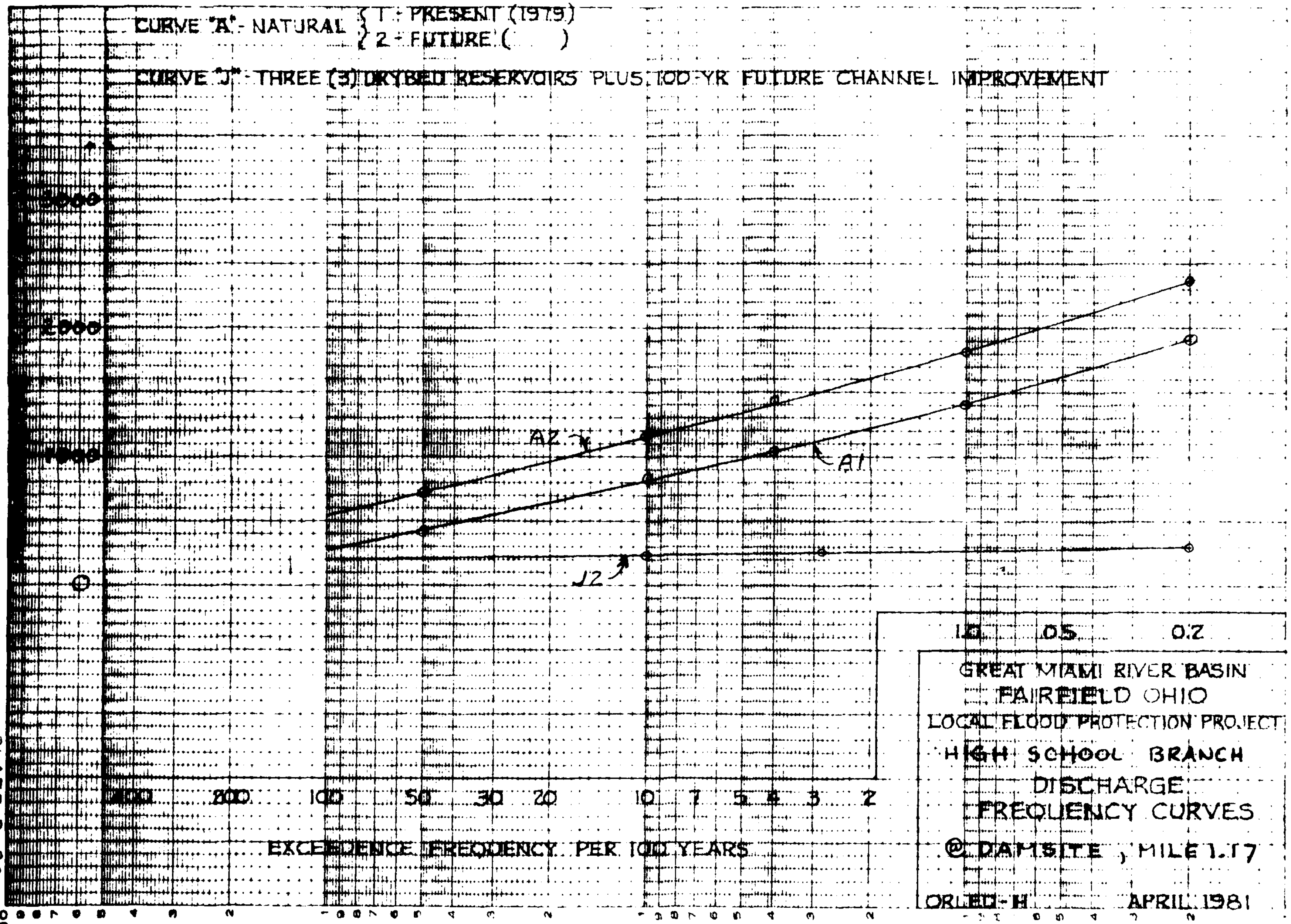

CURVE "A" - NATURAL { 1 - PRESENT (1979) / 2 - FUTURE ( ) }
CURVE "J" - THREE (3) DRYBED RESERVOIRS PLUS 100-YR. FUTURE CHANNEL IMPROVEMENT
4000
3000
2000
1000
0
A2
A1
J2
400 200 100 50 30 20 10 7 5 4 3 2 1.0 0.5 0.2
EXCEEDENCE FREQUENCY PER 100 YEARS
GREAT MIAMI RIVER BASIN
FAIRFIELD OHIO
LOCAL FLOOD PROTECTION PROJECT
HIGH SCHOOL BRANCH
DISCHARGE
FREQUENCY CURVES
@ MOUTH
ORLHD-H APRIL 1981

PLATE D-19



CURVE "A" - NATURAL { 1 - PRESENT (1979) 2 - FUTURE ( )
CURVE "J" - THREE (3) DRYBED RESERVOIRS PLUS 100-YR FUTURE CHANNEL IMPROVEMENT
3000
2000
1000
0
A2
A1
J2
400 200 100 50 30 20 10 7 5 4 3 2 1.0 .05 0.2
EXCEEDENCE FREQUENCY PER 100 YEARS
GREAT MIAMI RIVER BASIN
FAIRFIELD OHIO
LOCAL FLOOD PROTECTION PROJECT
HIGH SCHOOL BRANCH
DISCHARGE
FREQUENCY CURVES
@ DAMSITE, MILE 1.17
ORLED-H APRIL 1981

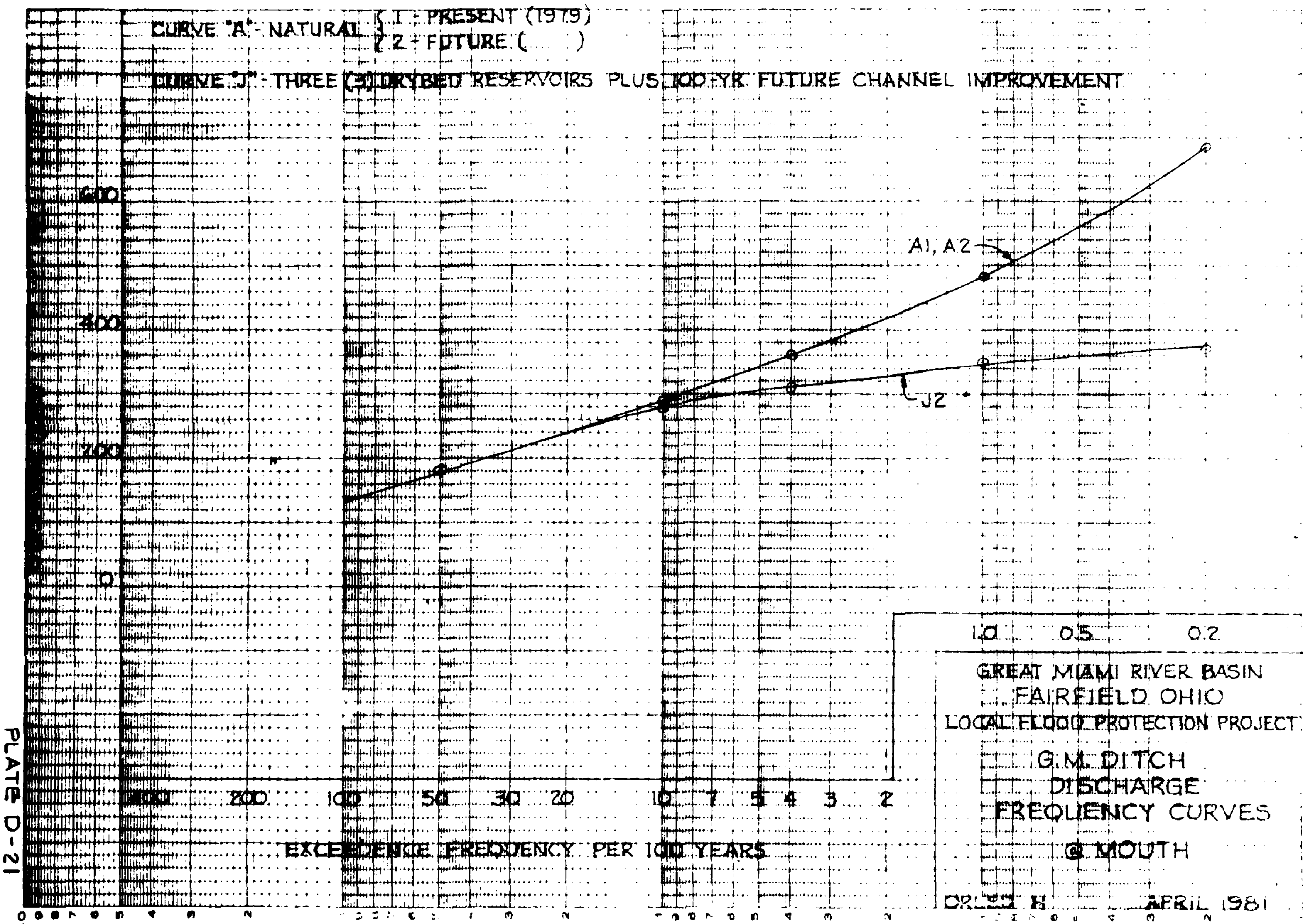
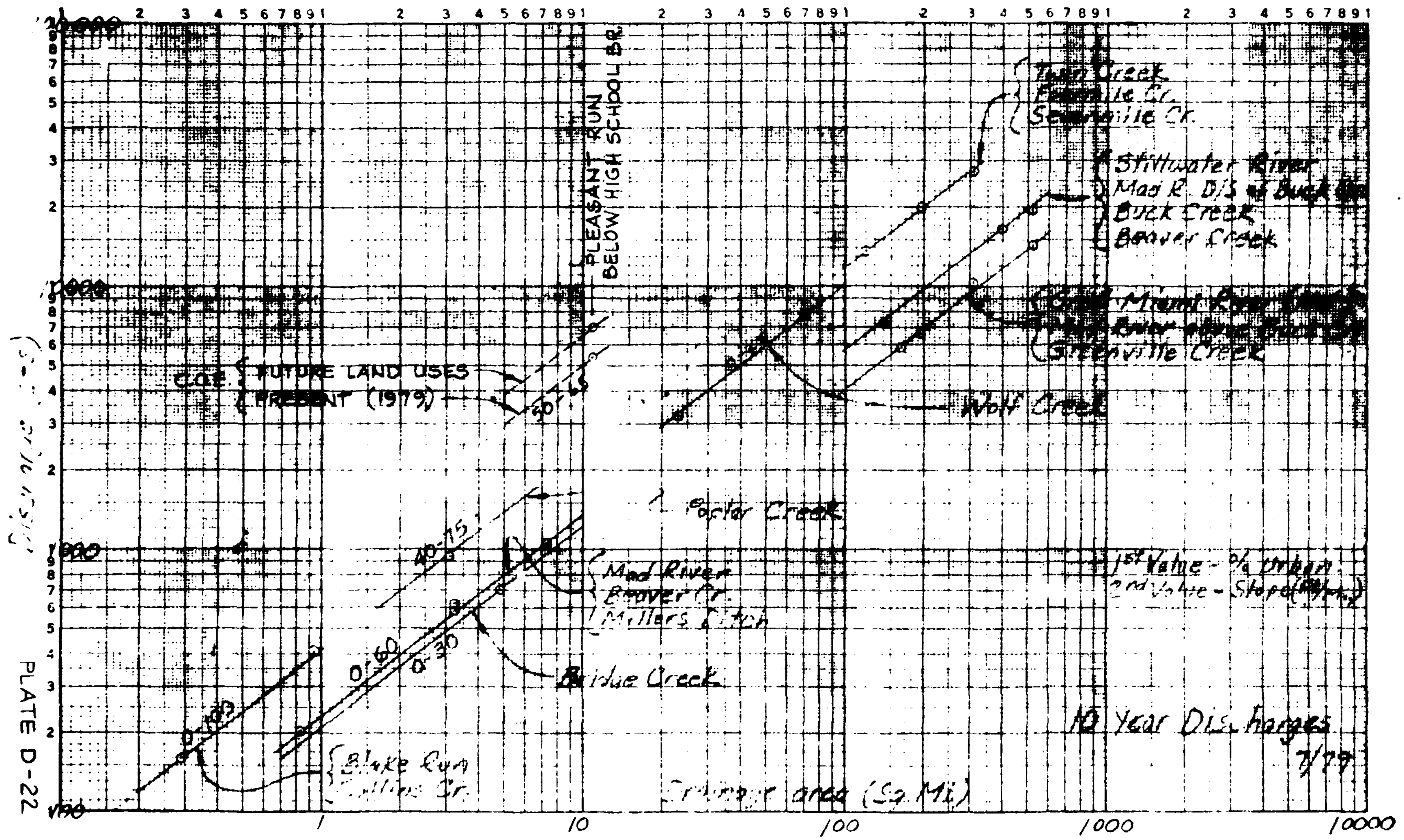

CURVE "A" - NATURAL { 1 - PRESENT (1979)
2 - FUTURE ( )
CURVE "J" - THREE (3) DRYBED RESERVOIRS PLUS 100-YR. FUTURE CHANNEL IMPROVEMENT
600
400
200
0
A1, A2
J2
500 200 100 50 30 20 10 7 5 4 3 2 1.0 0.5 0.2
EXCEEDENCE FREQUENCY PER 100 YEARS
GREAT MIAMI RIVER BASIN
FAIRFIELD OHIO
LOCAL FLOOD PROTECTION PROJECT
G.M. DITCH
DISCHARGE
FREQUENCY CURVES
@ MOUTH
APRIL 1981

PLATE D-21



PLEASANT RUN
BELOW HIGH SCHOOL BR
COE
FUTURE LAND USES
PRESENT (1979)
Porter Creek
Mad River
Beaver Cr.
Millers Ditch
Bridge Creek
Blake Run
Wolf Creek
Twin Creek
Stillwater River
Mad R. D/S of Buck Cr.
Buck Creek
Beaver Creek
Greenville Creek
1st Value - % Urban
2nd Value - Slope
10 Year Discharges
7/79
Drainage area (Sq. Mi.)
1000
10000
1
10
100

PLATE D-22

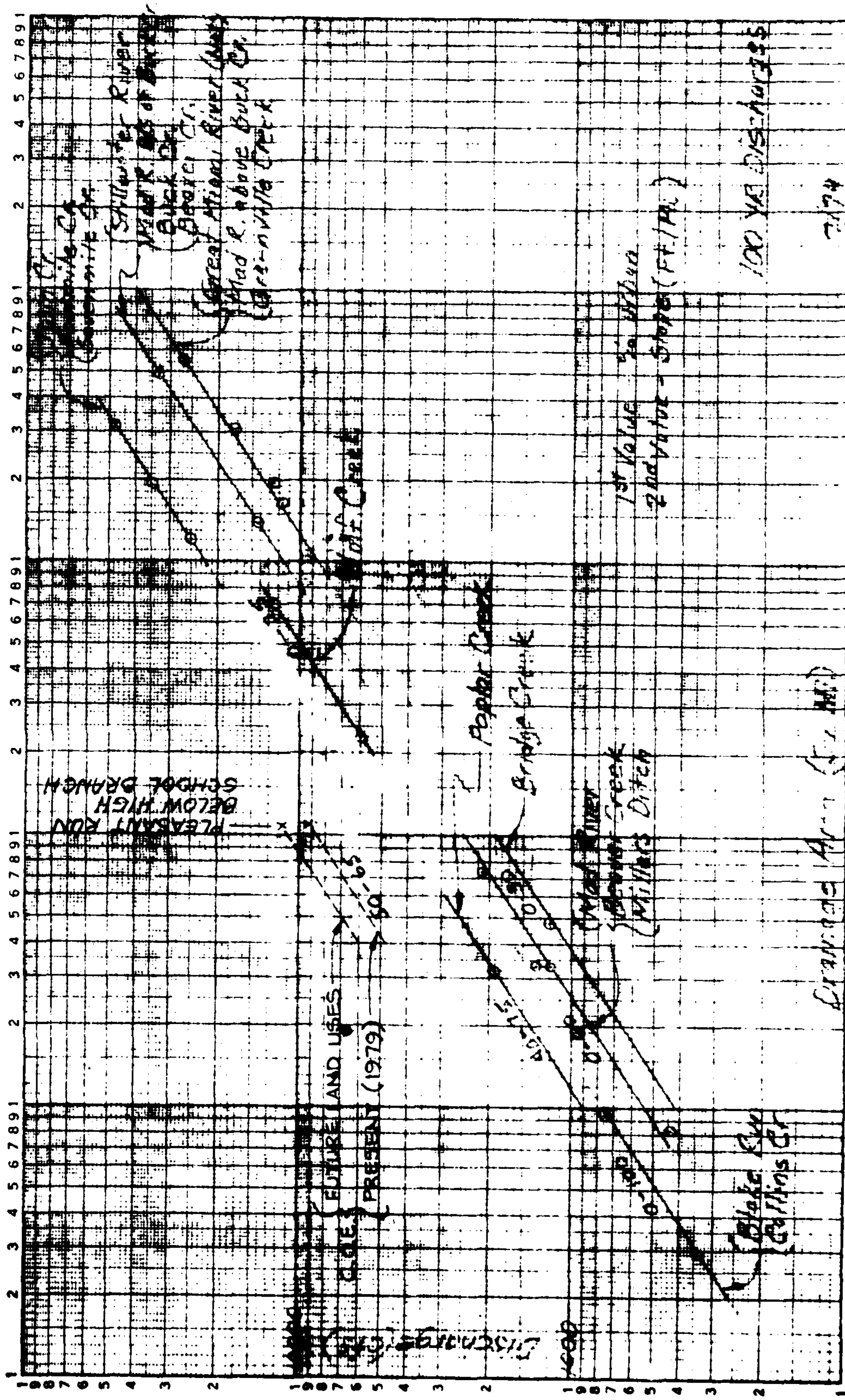

100 YR DISCHARGES
1st Value
2nd Value - Slope (Ft/Mi)
Drainage Area (Sq. Mi)
FUTURE LAND USES
PRESENT (1979)
Poplar Creek
Bridge Creek
Stillwater River
Mad R. above Buck Cr.
Blake Run
Collins Cr.
1000
100
10

PLATE D-23

RESPONSE TO PARAGRAPH 8 - Continued

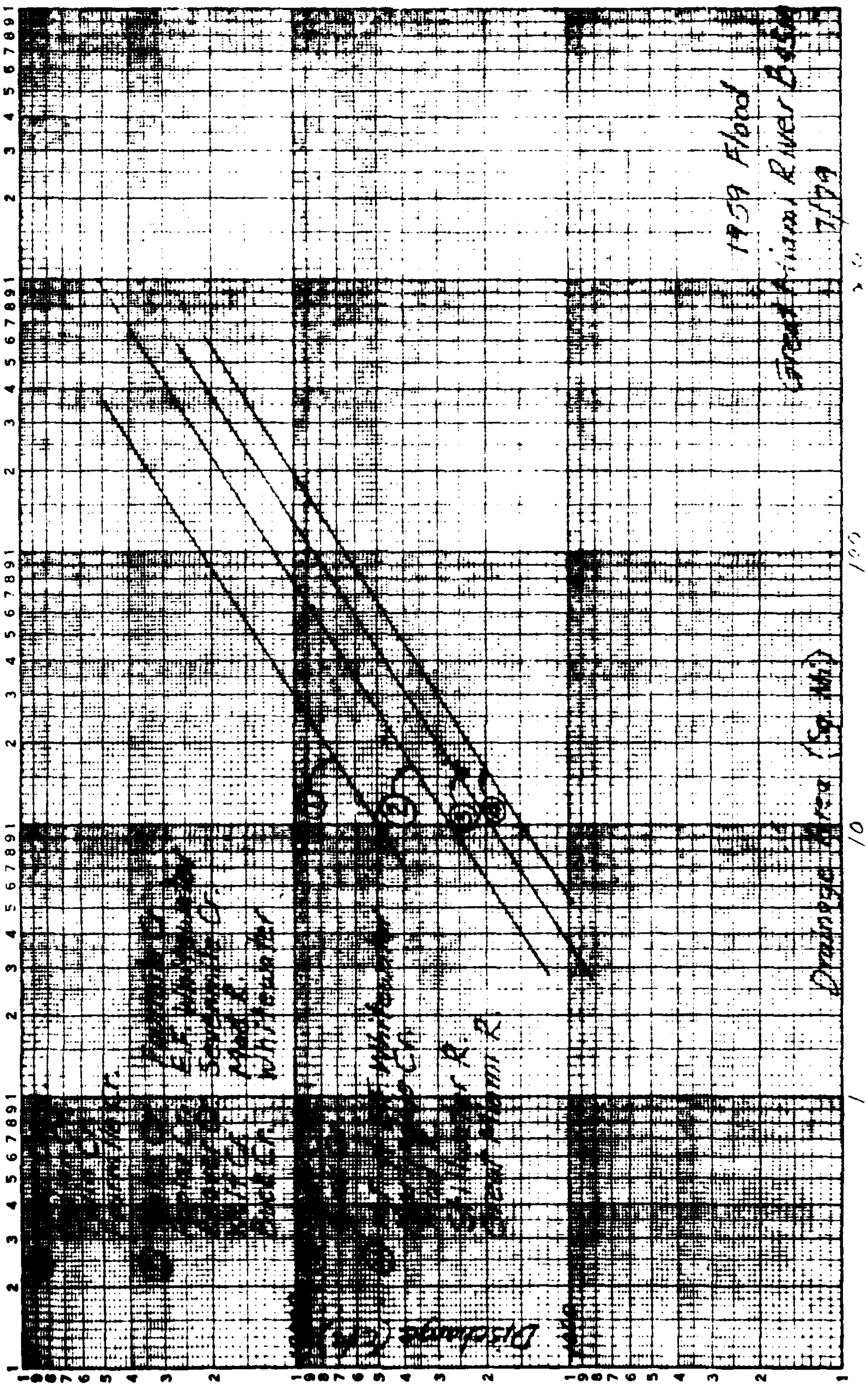
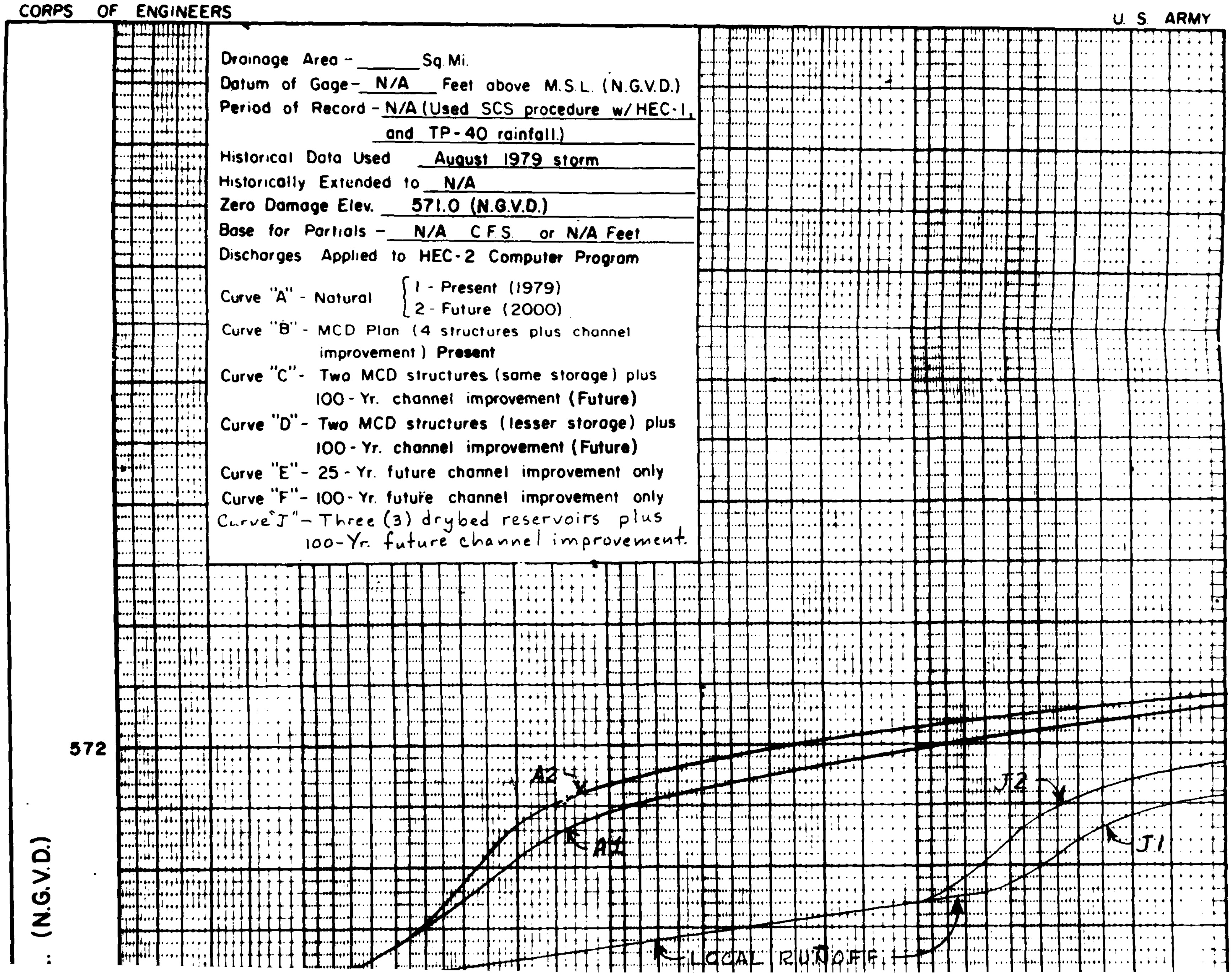
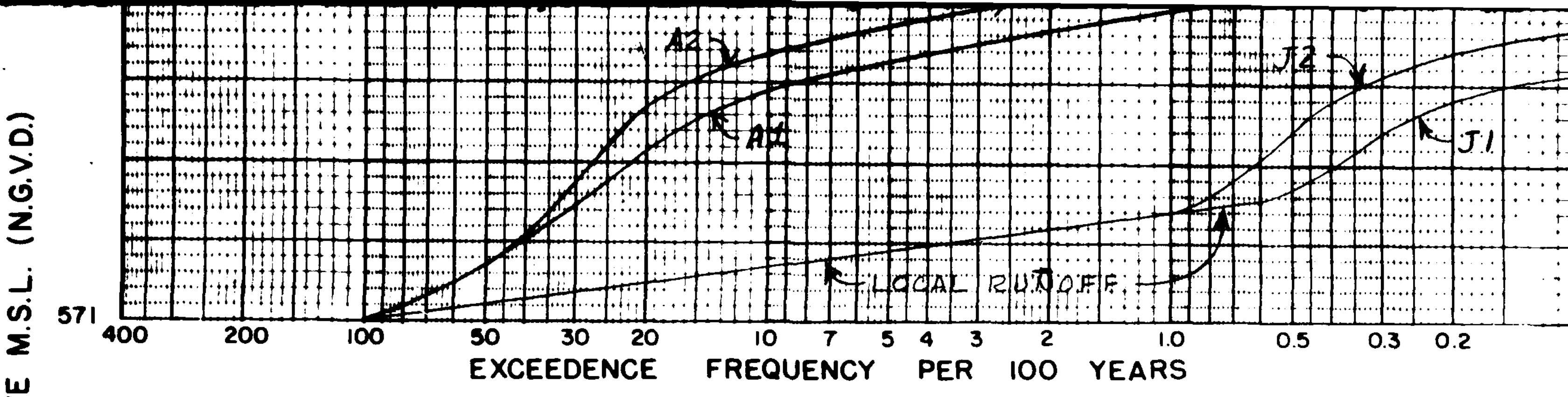
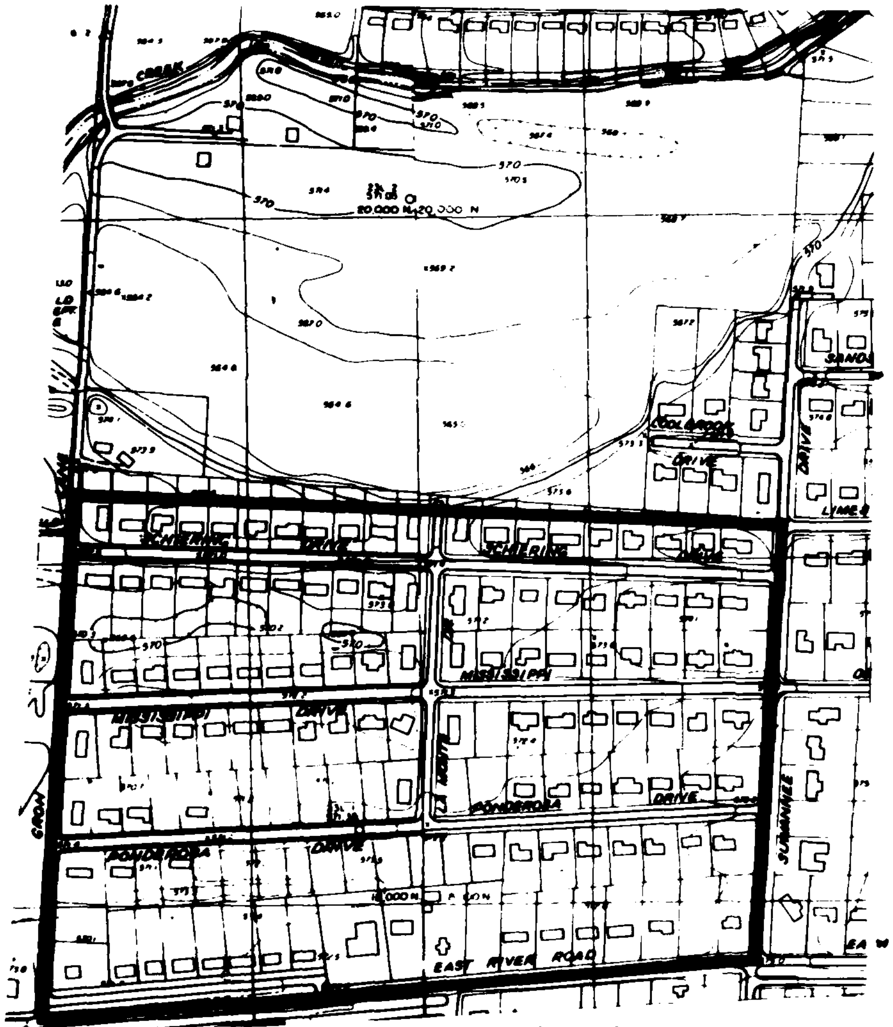


PLATE D-24

45


CORPS OF ENGINEERS
U. S. ARMY
Drainage Area - ______ Sq. Mi.
Datum of Gage - N/A Feet above M.S.L. (N.G.V.D.)
Period of Record - N/A (Used SCS procedure w/HEC-1, and TP-40 rainfall.)
Historical Data Used August 1979 storm
Historically Extended to N/A
Zero Damage Elev. 571.0 (N.G.V.D.)
Base for Partials - N/A C.F.S. or N/A Feet
Discharges Applied to HEC-2 Computer Program
Curve "A" - Natural { 1 - Present (1979) 2 - Future (2000)
Curve "B" - MCD Plan (4 structures plus channel improvement) Present
Curve "C" - Two MCD structures (same storage) plus 100-Yr. channel improvement (Future)
Curve "D" - Two MCD structures (lesser storage) plus 100-Yr. channel improvement (Future)
Curve "E" - 25-Yr. future channel improvement only
Curve "F" - 100-Yr. future channel improvement only
Curve "J" - Three (3) drybed reservoirs plus 100-Yr. future channel improvement.
572
(N.G.V.D.)
A2
A1
J2
J1
LOCAL RUNOFF





SCALE: 1" = 500'

GREAT MIAMI RIVER BASIN

FAIRFIELD OHIO

LOCAL FLOOD PROTECTION PROJECT

PLEASANT RUN

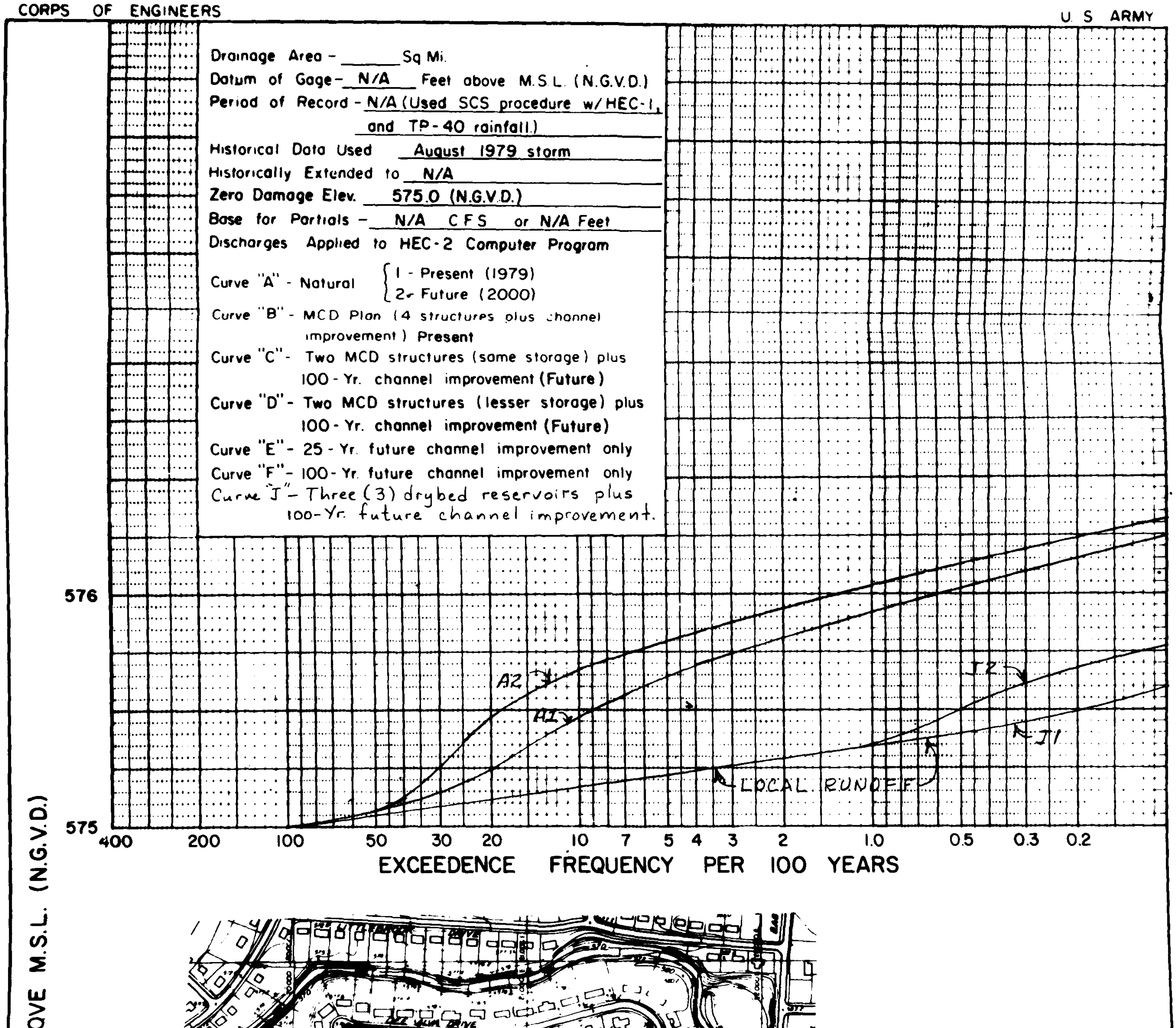
ELEVATION FREQUENCY CURVES

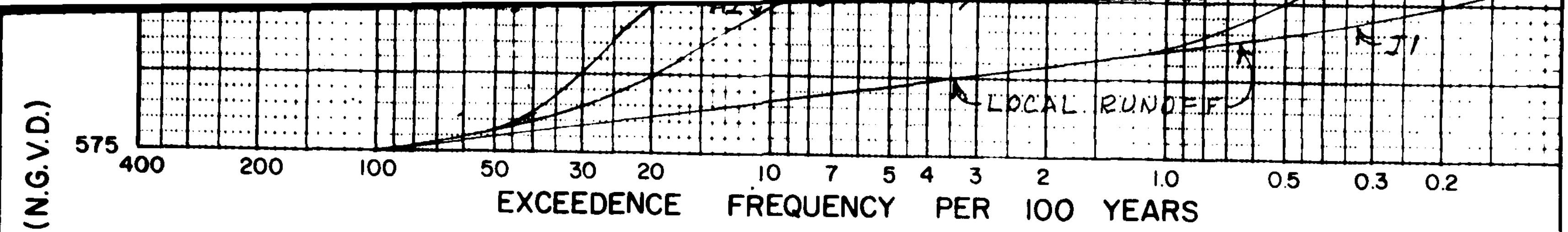
MILE N/A REACH PR-2

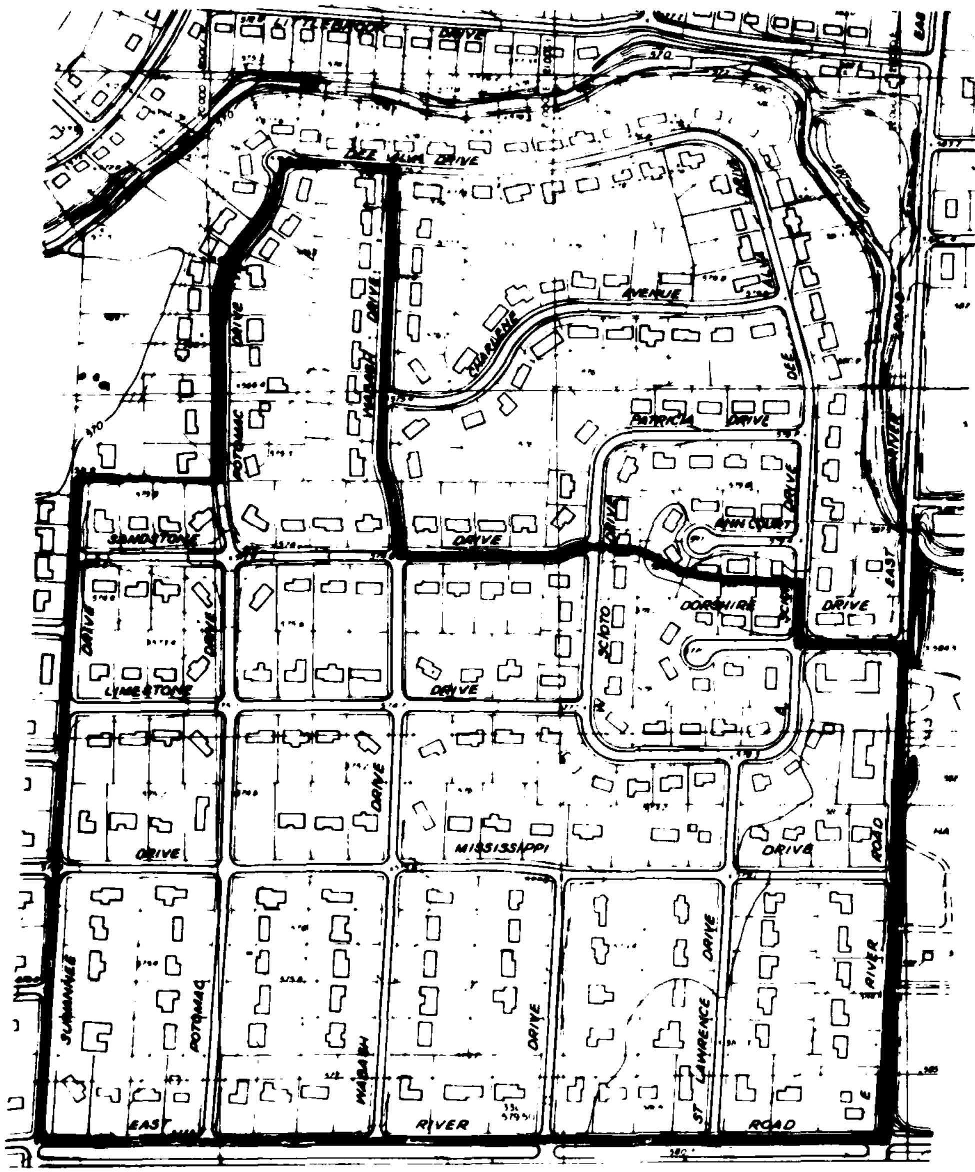
ORLED-H APRIL 1981

Approved by ___ ___ Transmitted to ______ on ______ 1981

PLATE D-25


CORPS OF ENGINEERS
U S ARMY
Drainage Area - ______ Sq Mi.
Datum of Gage - N/A Feet above M.S.L. (N.G.V.D.)
Period of Record - N/A (Used SCS procedure w/HEC-1, and TP-40 rainfall.)
Historical Data Used August 1979 storm
Historically Extended to N/A
Zero Damage Elev. 575.0 (N.G.V.D.)
Base for Partials - N/A CFS or N/A Feet
Discharges Applied to HEC-2 Computer Program
Curve "A" - Natural
1 - Present (1979)
2 - Future (2000)
Curve "B" - MCD Plan (4 structures plus channel improvement) Present
Curve "C" - Two MCD structures (same storage) plus 100-Yr. channel improvement (Future)
Curve "D" - Two MCD structures (lesser storage) plus 100-Yr. channel improvement (Future)
Curve "E" - 25-Yr. future channel improvement only
Curve "F" - 100-Yr. future channel improvement only
Curve "J" - Three (3) drybed reservoirs plus 100-Yr. future channel improvement.
A2
A1
J2
J1
LOCAL RUNOFF
576
575
400
200
100
50
30
20
10
7
5
4
3
2
1.0
0.5
0.3
0.2
EXCEEDENCE FREQUENCY PER 100 YEARS
OVE M.S.L. (N.G.V.D.)





SCALE: 1" = 500'

GREAT MIAMI RIVER BASIN
FAIRFIELD OHIO
LOCAL FLOOD PROTECTION PROJECT

PLEASANT RUN

ELEVATION
FREQUENCY CURVES

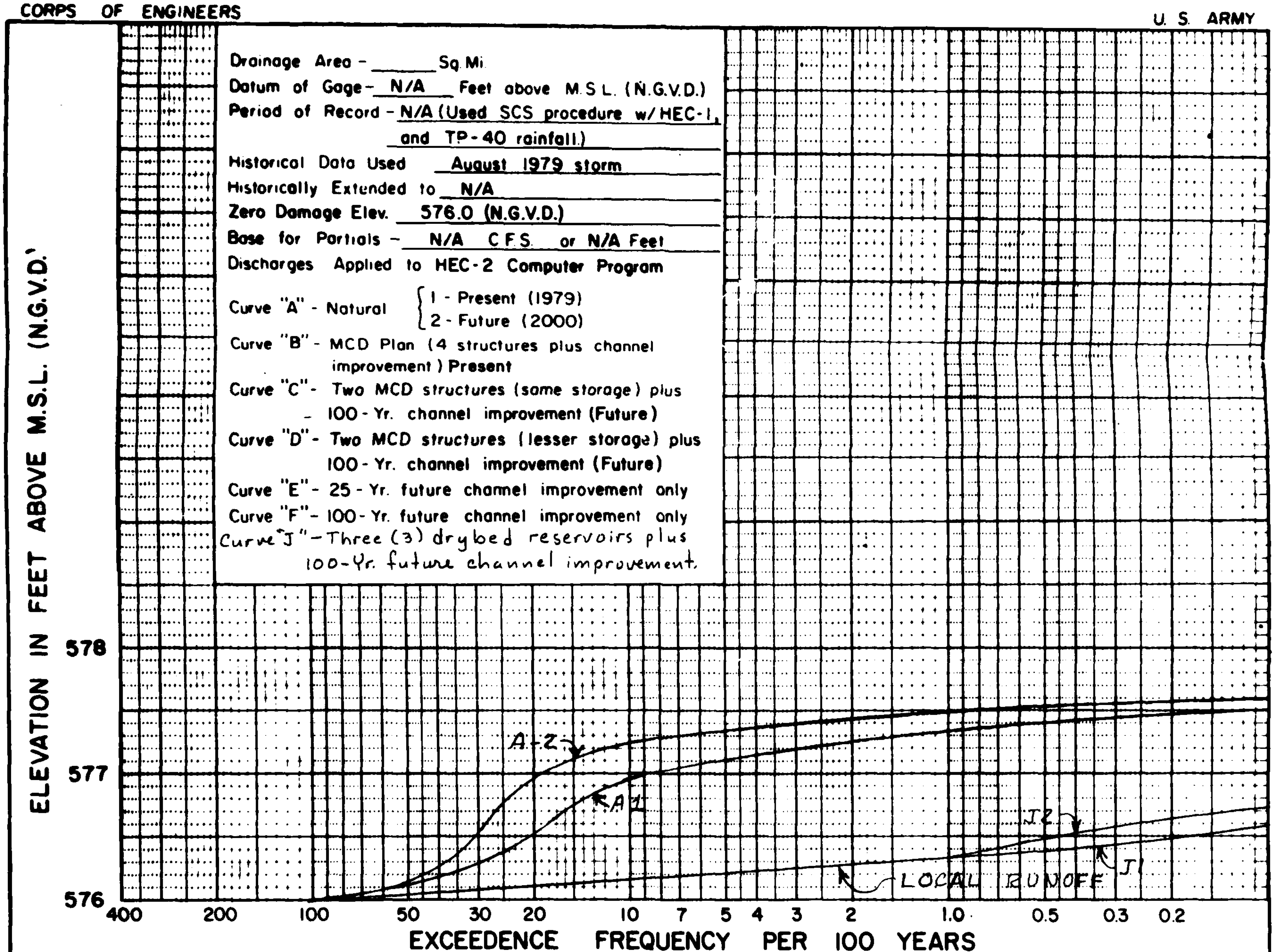
MILE N/A REACH PR-3

ORLED-H APRIL 1981

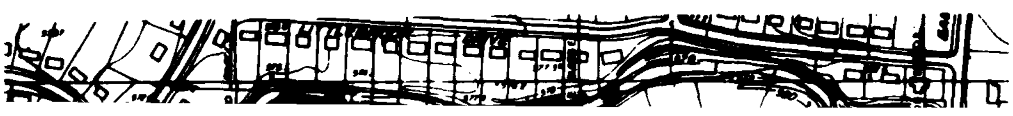
Approved by ___ ___ Transmitted to ______ on ______ 1981

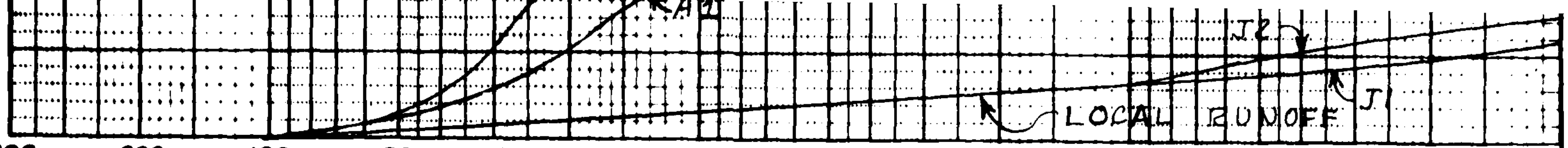
PLATE D-26

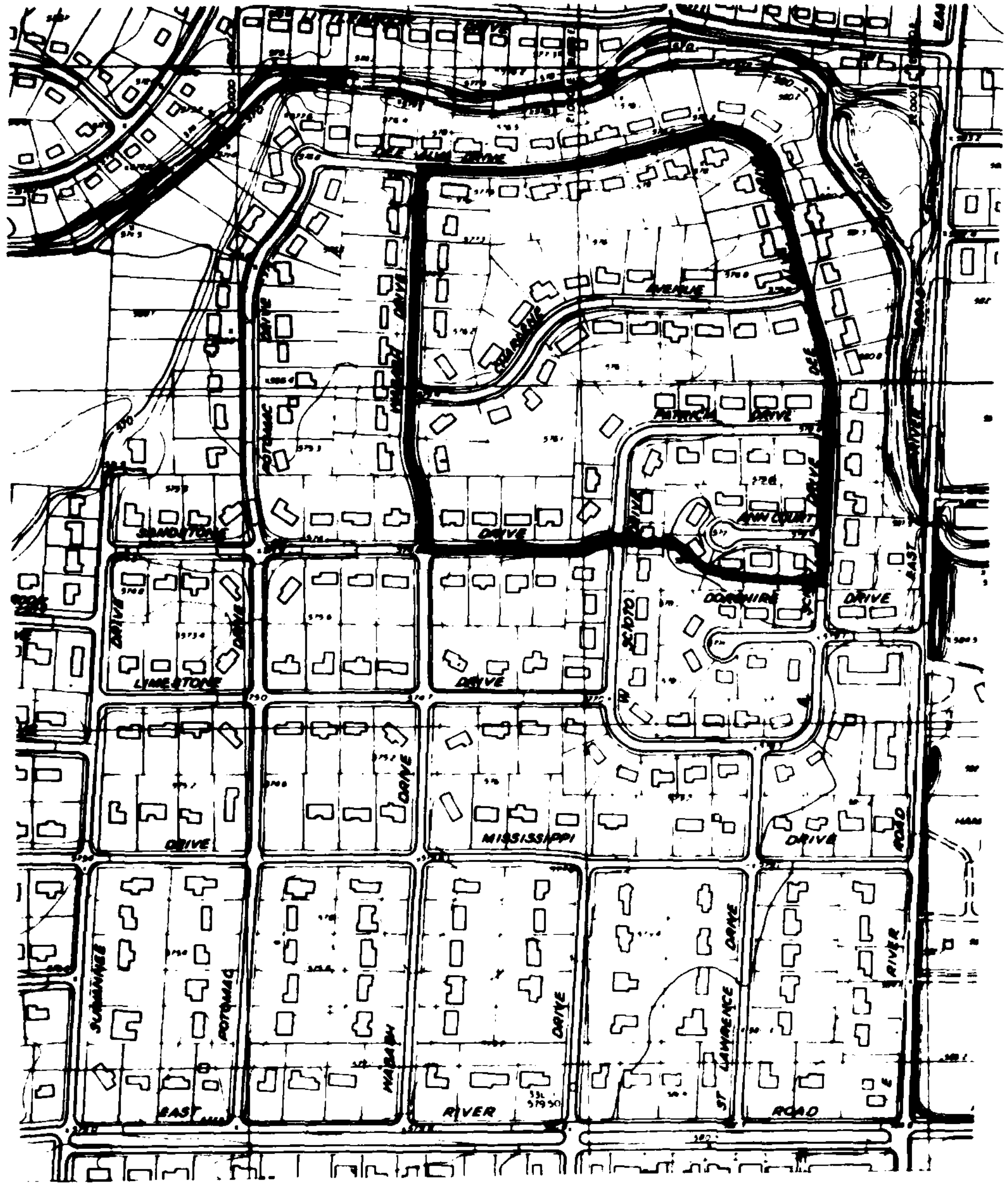
2



CORPS OF ENGINEERS
U. S. ARMY
Drainage Area - ______ Sq. Mi.
Datum of Gage - N/A Feet above M.S.L. (N.G.V.D.)
Period of Record - N/A (Used SCS procedure w/HEC-1, and TP-40 rainfall)
Historical Data Used August 1979 storm
Historically Extended to N/A
Zero Damage Elev. 576.0 (N.G.V.D.)
Base for Partials - N/A C.F.S. or N/A Feet
Discharges Applied to HEC-2 Computer Program
Curve "A" - Natural {1 - Present (1979) / 2 - Future (2000)
Curve "B" - MCD Plan (4 structures plus channel improvement) Present
Curve "C" - Two MCD structures (same storage) plus 100-Yr. channel improvement (Future)
Curve "D" - Two MCD structures (lesser storage) plus 100-Yr. channel improvement (Future)
Curve "E" - 25-Yr. future channel improvement only
Curve "F" - 100-Yr. future channel improvement only
Curve "J" - Three (3) drybed reservoirs plus 100-Yr. future channel improvement.
A-2
A-1
J2
J1
LOCAL RUNOFF
ELEVATION IN FEET ABOVE M.S.L. (N.G.V.D.)
578
577
576
400
200
100
50
30
20
10
7
5
4
3
2
1.0
0.5
0.3
0.2
EXCEEDENCE FREQUENCY PER 100 YEARS







SCALE : 1" = 500'

GREAT MIAMI RIVER BASIN
FAIRFIELD OHIO
LOCAL FLOOD PROTECTION PROJECT

PLEASANT RUN

ELEVATION FREQUENCY CURVES

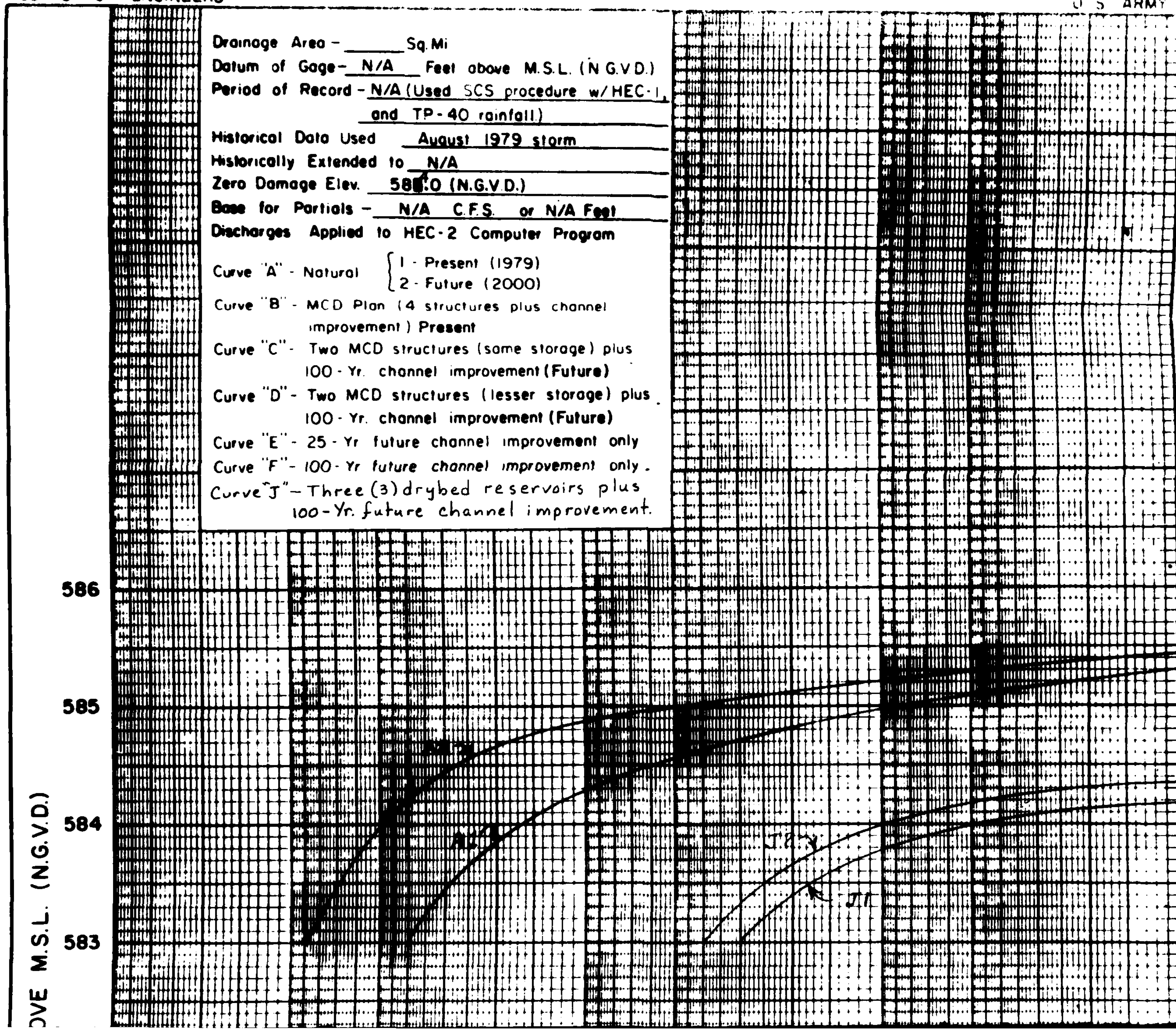
MILE N/A **REACH PR-3A**

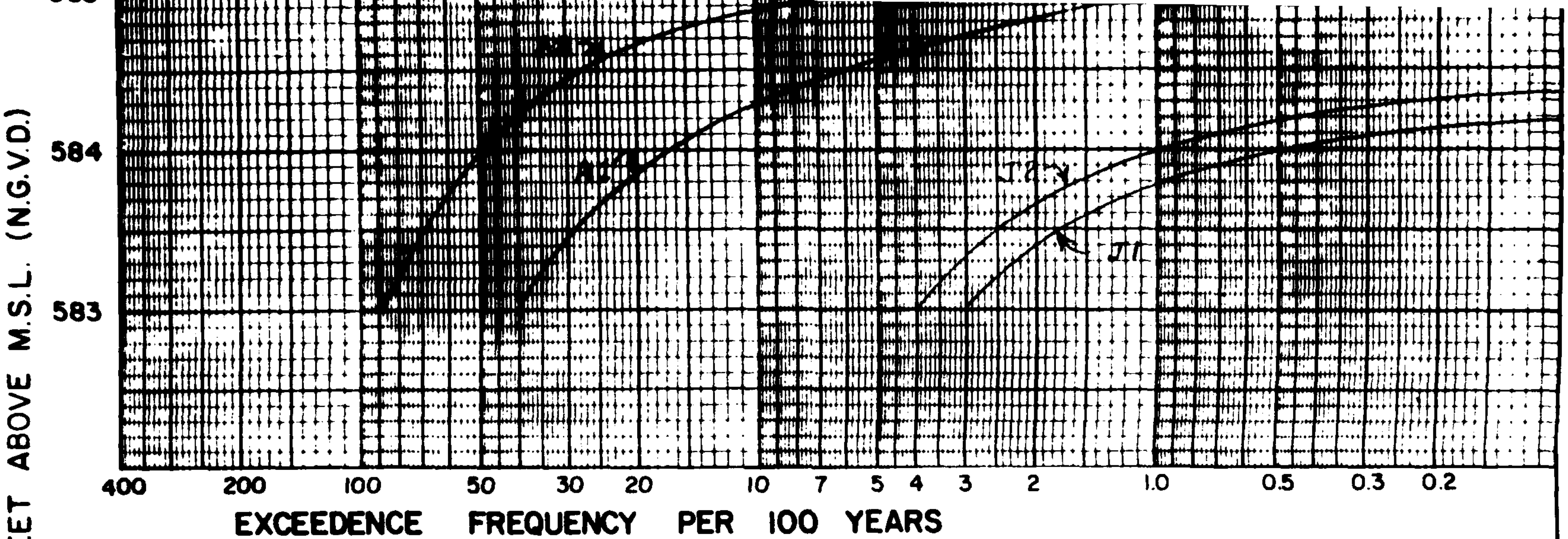
ORLED-H APRIL 1981

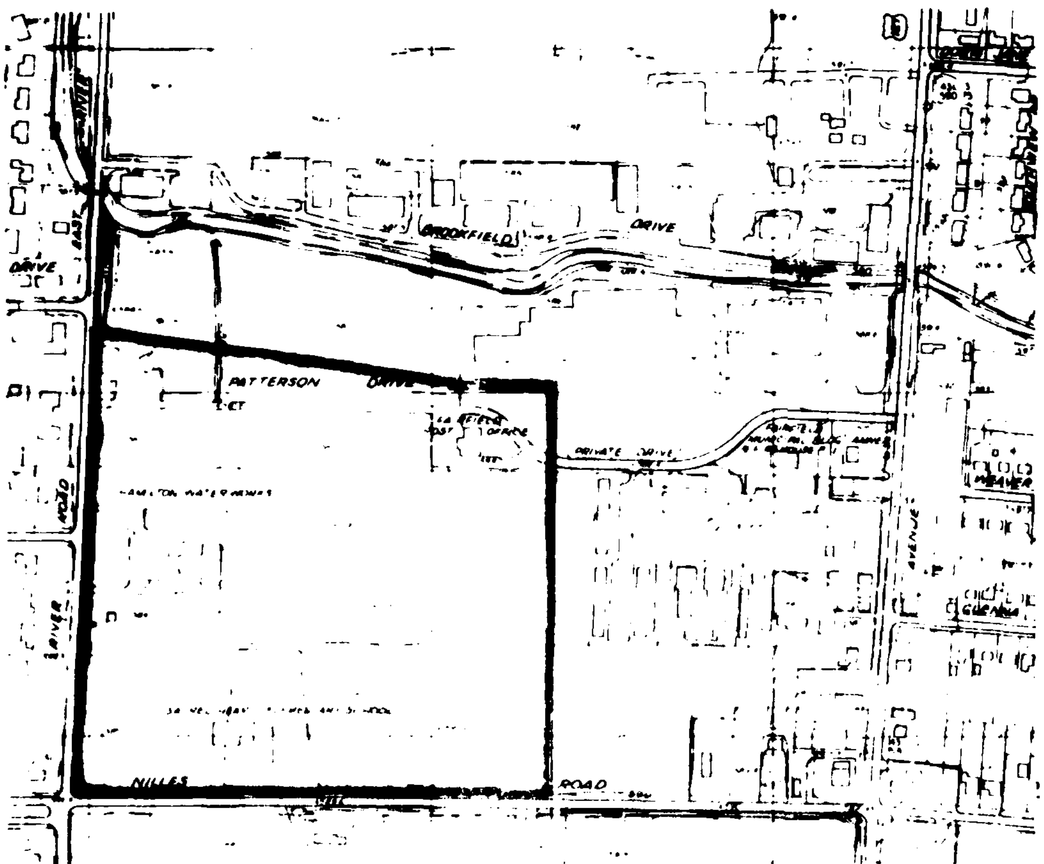
Approved by ___ ___ Transmitted to _____ on _____ 1981

2

PLATE D-27


CORPS OF ENGINEERS
U S ARMY
Drainage Area - ______ Sq. Mi
Datum of Gage - N/A Feet above M.S.L. (N.G.V.D.)
Period of Record - N/A (Used SCS procedure w/HEC-1, and TP-40 rainfall)
Historical Data Used August 1979 storm
Historically Extended to N/A
Zero Damage Elev. 58[illegible].0 (N.G.V.D.)
Base for Partials - N/A C.F.S. or N/A Feet
Discharges Applied to HEC-2 Computer Program
Curve "A" - Natural {1 - Present (1979) 2 - Future (2000)}
Curve "B" - MCD Plan (4 structures plus channel improvement) Present
Curve "C" - Two MCD structures (same storage) plus 100-Yr. channel improvement (Future)
Curve "D" - Two MCD structures (lesser storage) plus 100-Yr. channel improvement (Future)
Curve "E" - 25-Yr future channel improvement only
Curve "F" - 100-Yr future channel improvement only.
Curve "J" - Three (3) drybed reservoirs plus 100-Yr. future channel improvement.
586
585
584
583
OVE M.S.L. (N.G.V.D.)
A-1
A-2
J-2
J-1





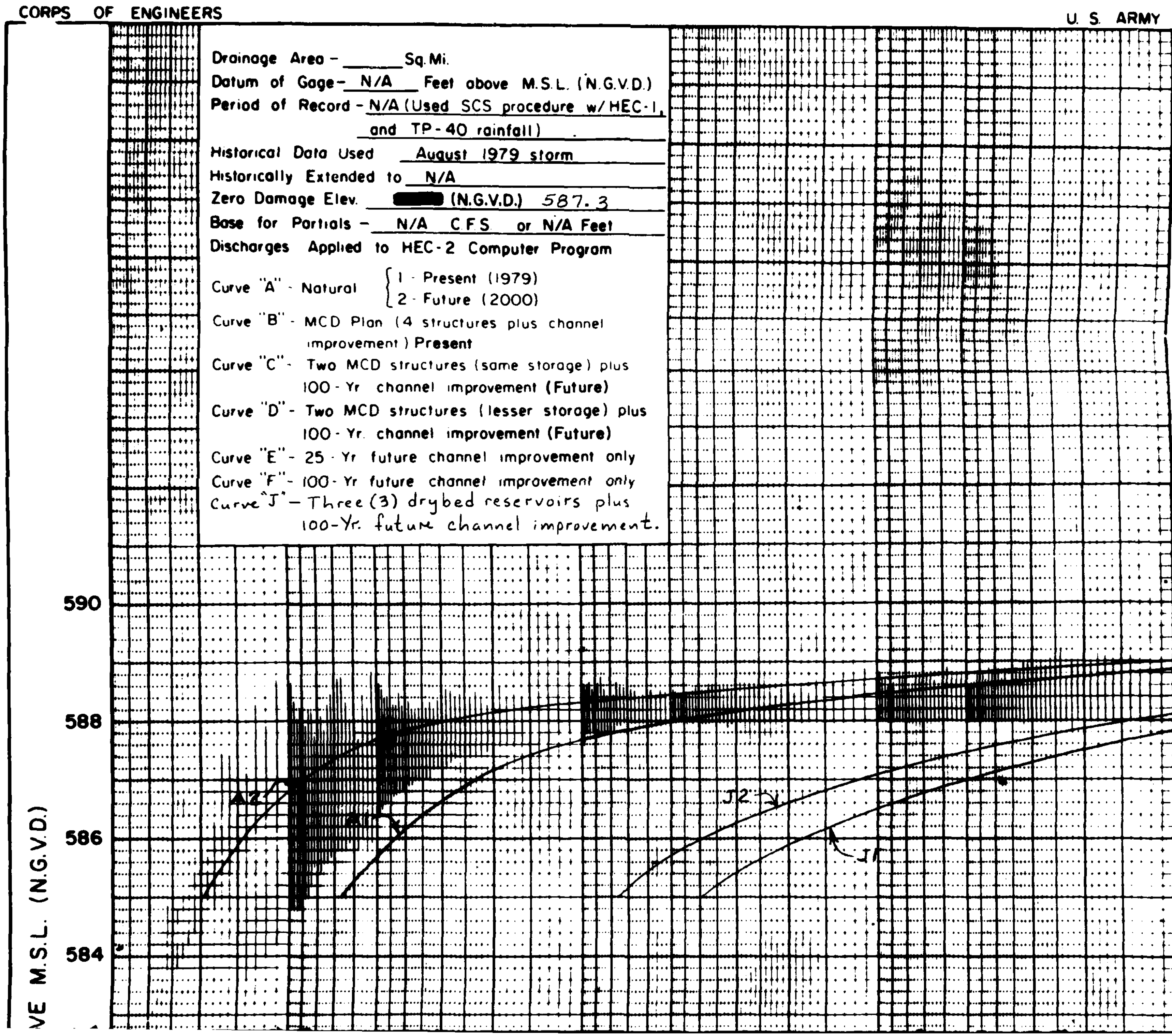
SCALE : 1" = 500'

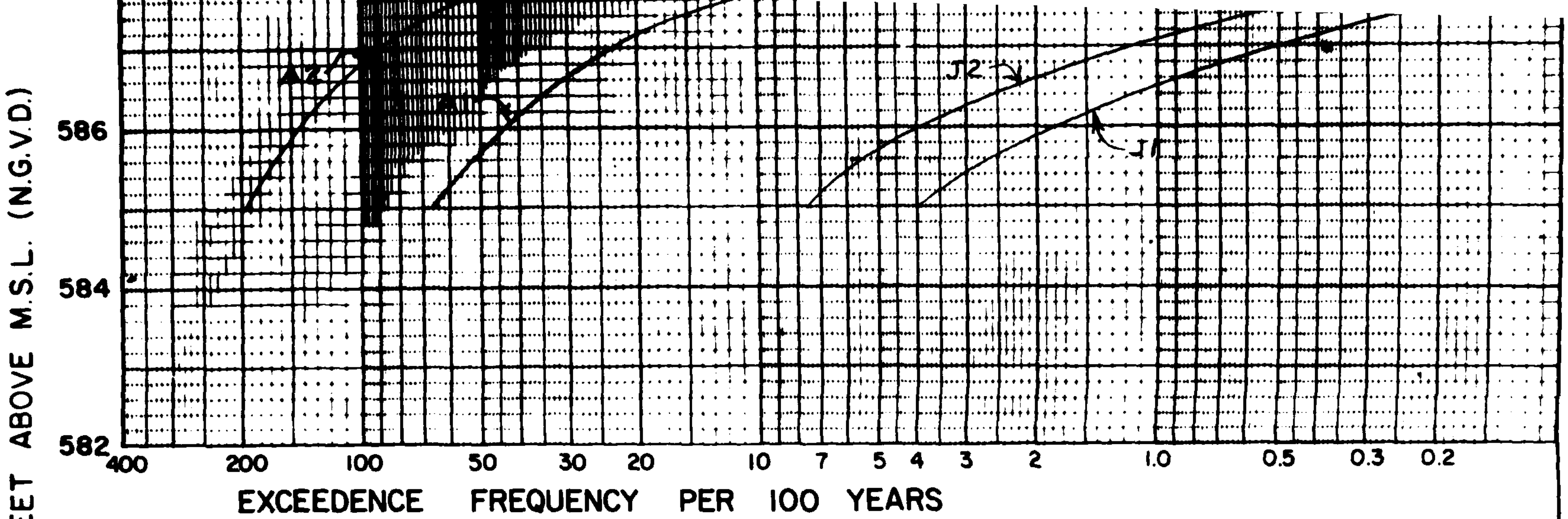
GREAT MIAMI RIVER BASIN
FAIRFIELD OHIO
LOCAL FLOOD PROTECTION PROJECT
PONDING AREA (S.W. SECTION OF RIVER ROAD & NILLES RD.)
ELEVATION
FREQUENCY CURVES
MILE 1.73 REACH PR-4A
ORLED-H APRIL 1981

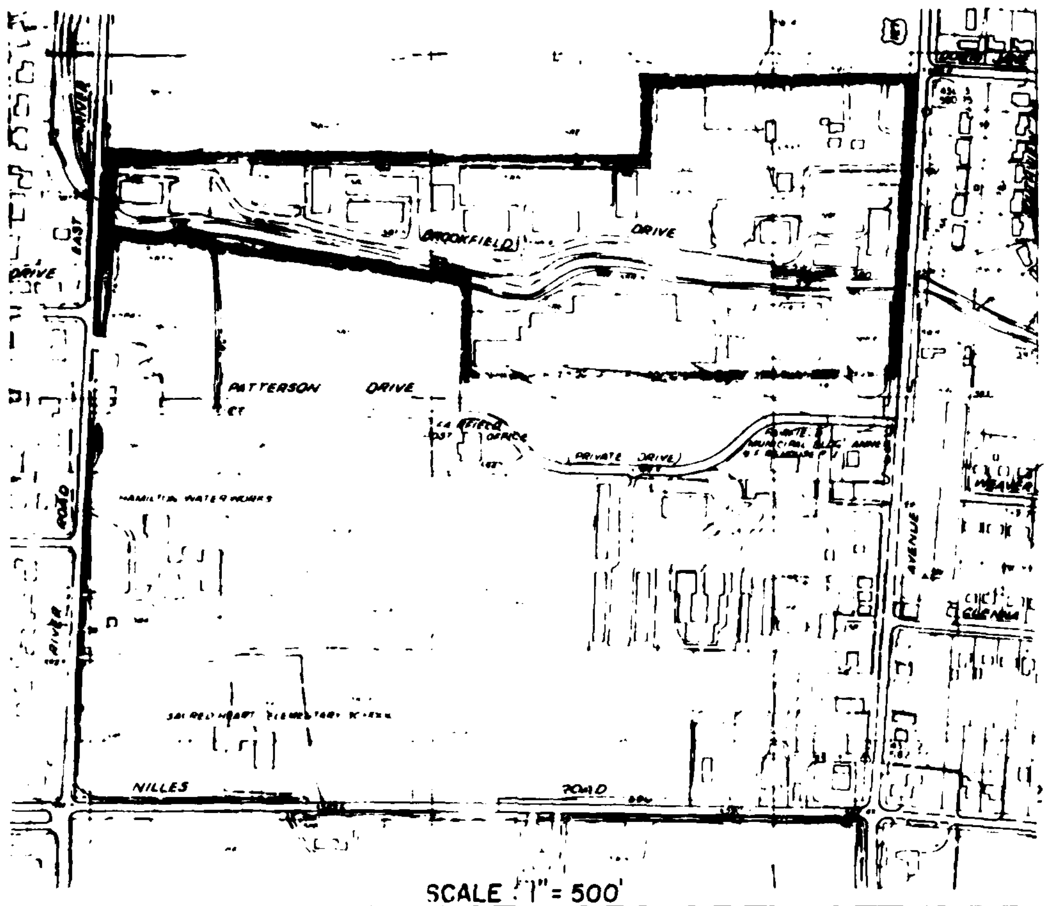
Approved by ______ Transmitted to ______ on ______ 1981

PLATE D-28

2


CORPS OF ENGINEERS
U. S. ARMY
Drainage Area - ______ Sq. Mi.
Datum of Gage - N/A Feet above M.S.L. (N.G.V.D.)
Period of Record - N/A (Used SCS procedure w/ HEC-1, and TP-40 rainfall)
Historical Data Used August 1979 storm
Historically Extended to N/A
Zero Damage Elev. [redacted] (N.G.V.D.) 587.3
Base for Partials - N/A CFS or N/A Feet
Discharges Applied to HEC-2 Computer Program
Curve "A" - Natural { 1 - Present (1979) 2 - Future (2000)
Curve "B" - MCD Plan (4 structures plus channel improvement) Present
Curve "C" - Two MCD structures (same storage) plus 100-Yr channel improvement (Future)
Curve "D" - Two MCD structures (lesser storage) plus 100-Yr. channel improvement (Future)
Curve "E" - 25-Yr future channel improvement only
Curve "F" - 100-Yr future channel improvement only
Curve "J" - Three (3) drybed reservoirs plus 100-Yr. future channel improvement.
590
588
586
584
VE M.S.L. (N.G.V.D.)
A2
A1
J2
J1





GREAT MIAMI RIVER BASIN

FAIRFIELD OHIO

LOCAL FLOOD PROTECTION PROJECT

PLEASANT RUN

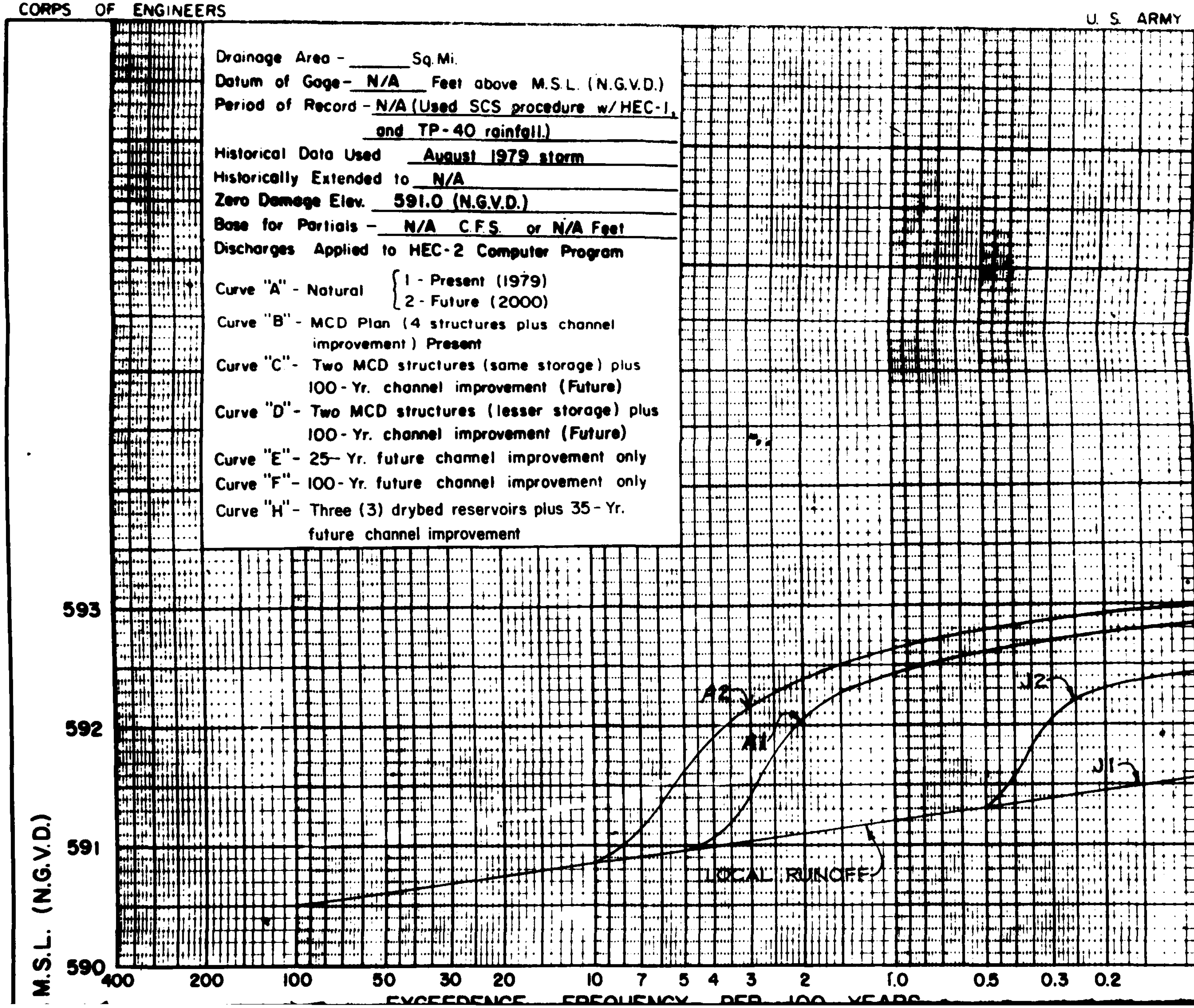
ELEVATION FREQUENCY CURVES

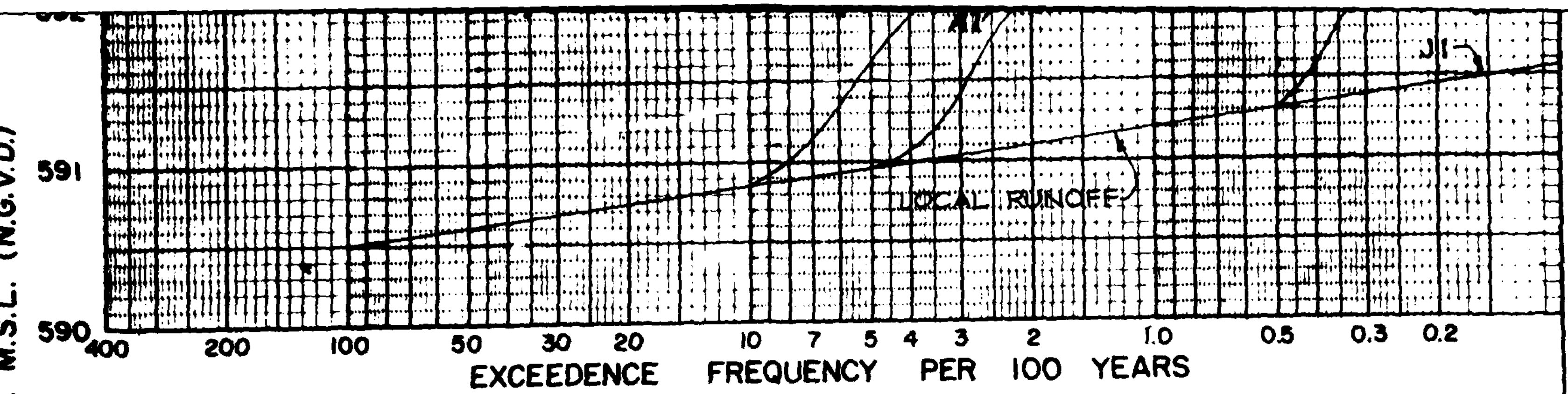
MILE 1.97 REACH PR-4B

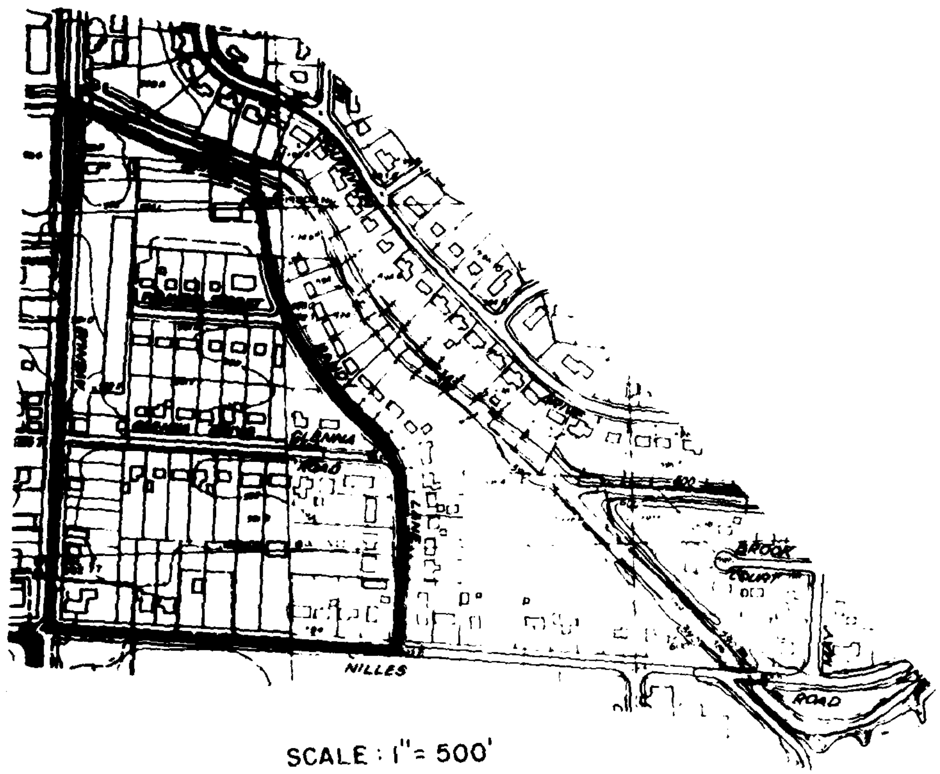
ORLED-H APRIL 1981

Approved by ___ ___ Transmitted to ______ on ______ 1981

2


CORPS OF ENGINEERS
U. S. ARMY
Drainage Area - ______ Sq. Mi.
Datum of Gage - N/A Feet above M.S.L. (N.G.V.D.)
Period of Record - N/A (Used SCS procedure w/HEC-1, and TP-40 rainfall.)
Historical Data Used August 1979 storm
Historically Extended to N/A
Zero Damage Elev. 591.0 (N.G.V.D.)
Base for Partials - N/A C.F.S. or N/A Feet
Discharges Applied to HEC-2 Computer Program
Curve "A" - Natural {1 - Present (1979) 2 - Future (2000)}
Curve "B" - MCD Plan (4 structures plus channel improvement) Present
Curve "C" - Two MCD structures (same storage) plus 100-Yr. channel improvement (Future)
Curve "D" - Two MCD structures (lesser storage) plus 100-Yr. channel improvement (Future)
Curve "E" - 25- Yr. future channel improvement only
Curve "F" - 100-Yr. future channel improvement only
Curve "H" - Three (3) drybed reservoirs plus 35-Yr. future channel improvement
A2
A1
J2
J1
LOCAL RUNOFF
593
592
591
590
M.S.L. (N.G.V.D.)
400
200
100
50
30
20
10
7
5
4
3
2
1.0
0.5
0.3
0.2





SCALE : 1" = 500'

GREAT MIAMI RIVER BASIN
FAIRFIELD OHIO
LOCAL FLOOD PROTECTION PROJECT
PLEASANT RUN
ELEVATION
FREQUENCY CURVES
MILE 2.18 - 2.69 REACH PR-5
ORLED-H APRIL 1981

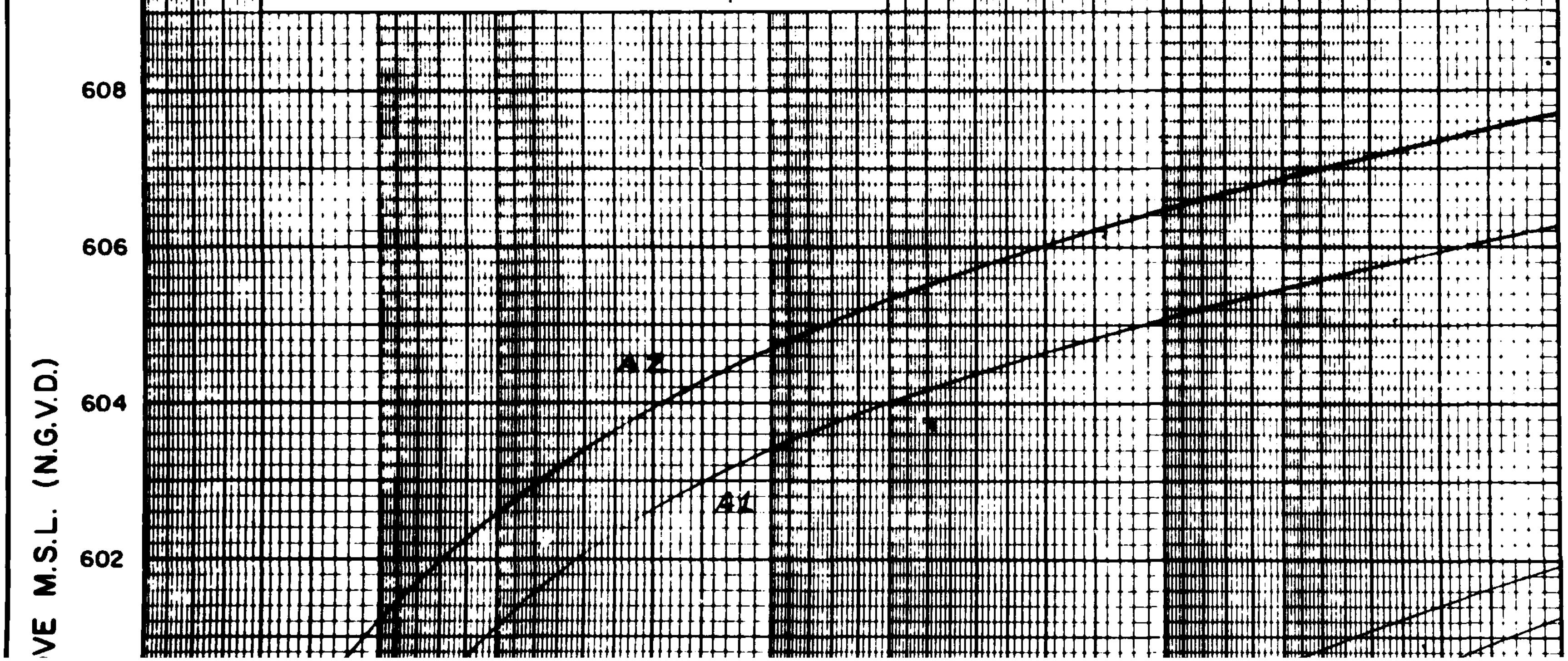
Approved by ___ ___ Transmitted to _____ on _____ 1981

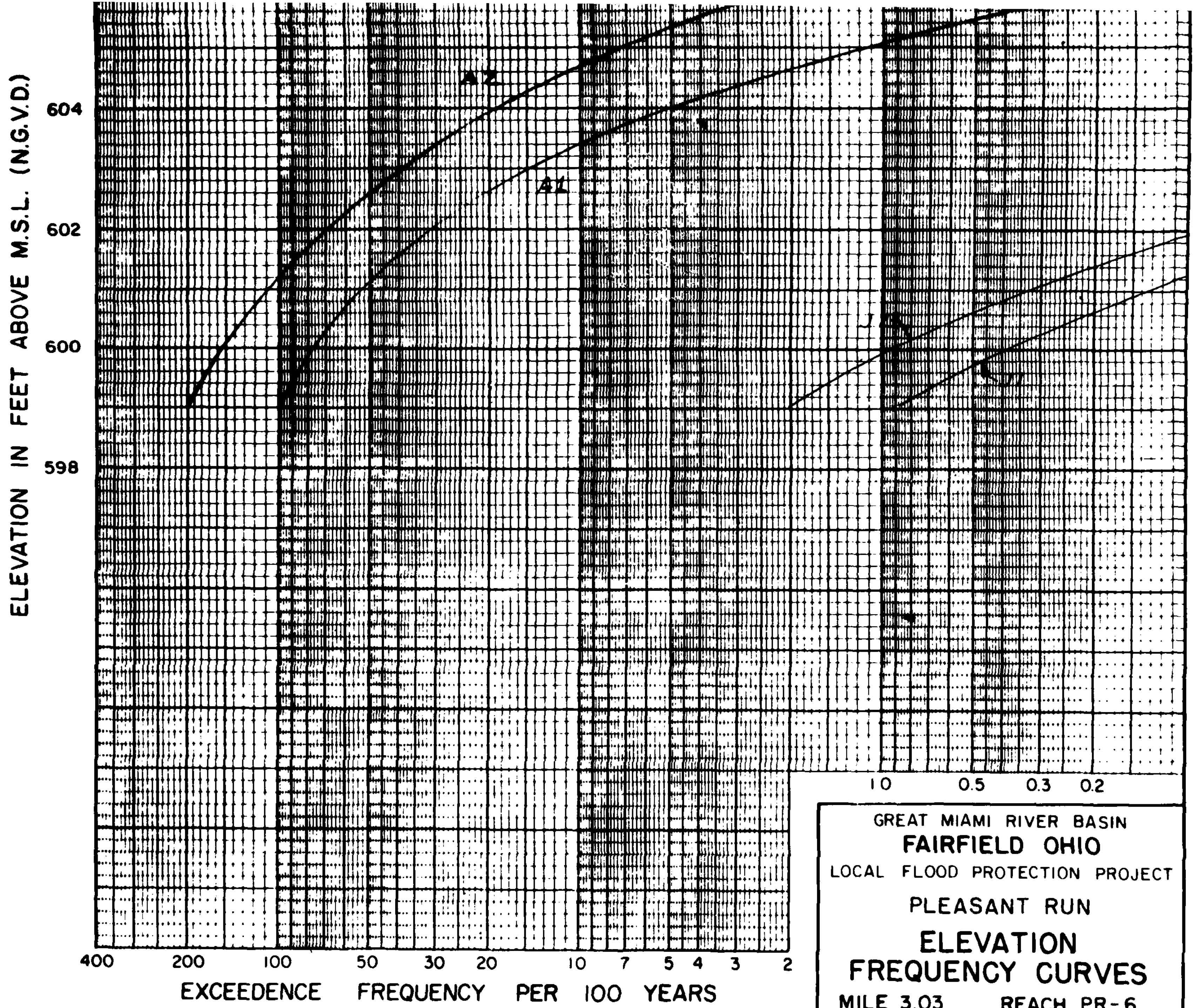
PLATE D-30

CORPS OF ENGINEERS — U. S. ARMY

Drainage Area - ______ Sq. Mi.
Datum of Gage - N/A Feet above M.S.L. (N.G.V.D.)
Period of Record - N/A (Used SCS procedure w/ HEC-1, and TP-40 rainfall.)
Historical Data Used August 1979 storm
Historically Extended to N/A
Zero Damage Elev. ______
Base for Partials - N/A C.F.S. or N/A Feet
Discharges Applied to HEC-2 Computer Program

Curve "A" - Natural { 1 - Present (1979); 2 - Future (2000) }
Curve "B" - MCD Plan (4 structures plus channel improvement)
Curve "C" - Two MCD structures (same storage) plus 100 - Yr. channel improvement
Curve "D" - Two MCD structures (lesser storage) plus 100 - Yr. channel improvement
Curve "E" - 25 - Yr. future channel improvement only
Curve "F" - 100 - Yr. future channel improvement only
Curve "J" - Three (3) drybed reservoirs plus 100-Yr. future channel improvement.





GREAT MIAMI RIVER BASIN
FAIRFIELD OHIO
LOCAL FLOOD PROTECTION PROJECT
PLEASANT RUN

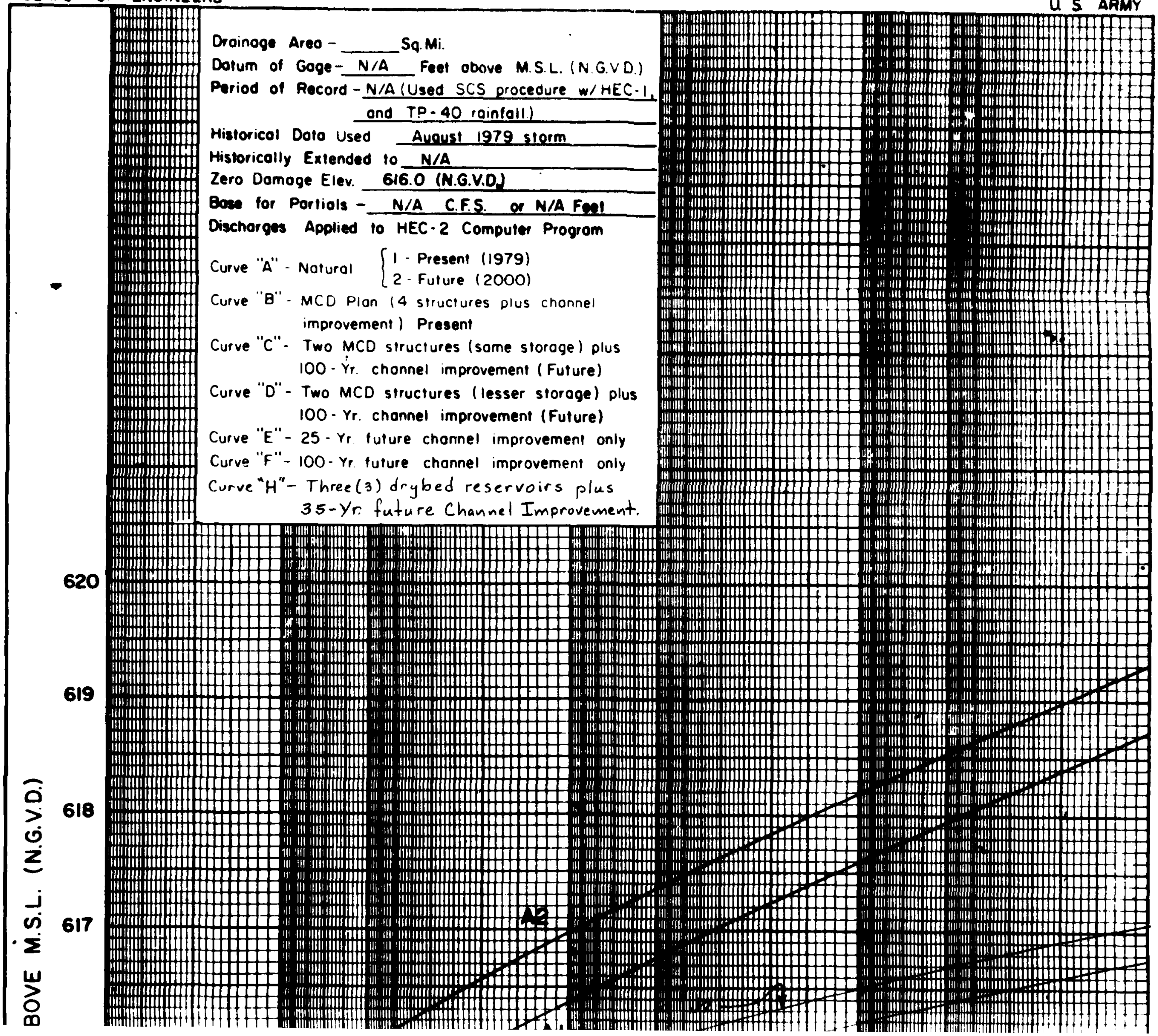
ELEVATION FREQUENCY CURVES

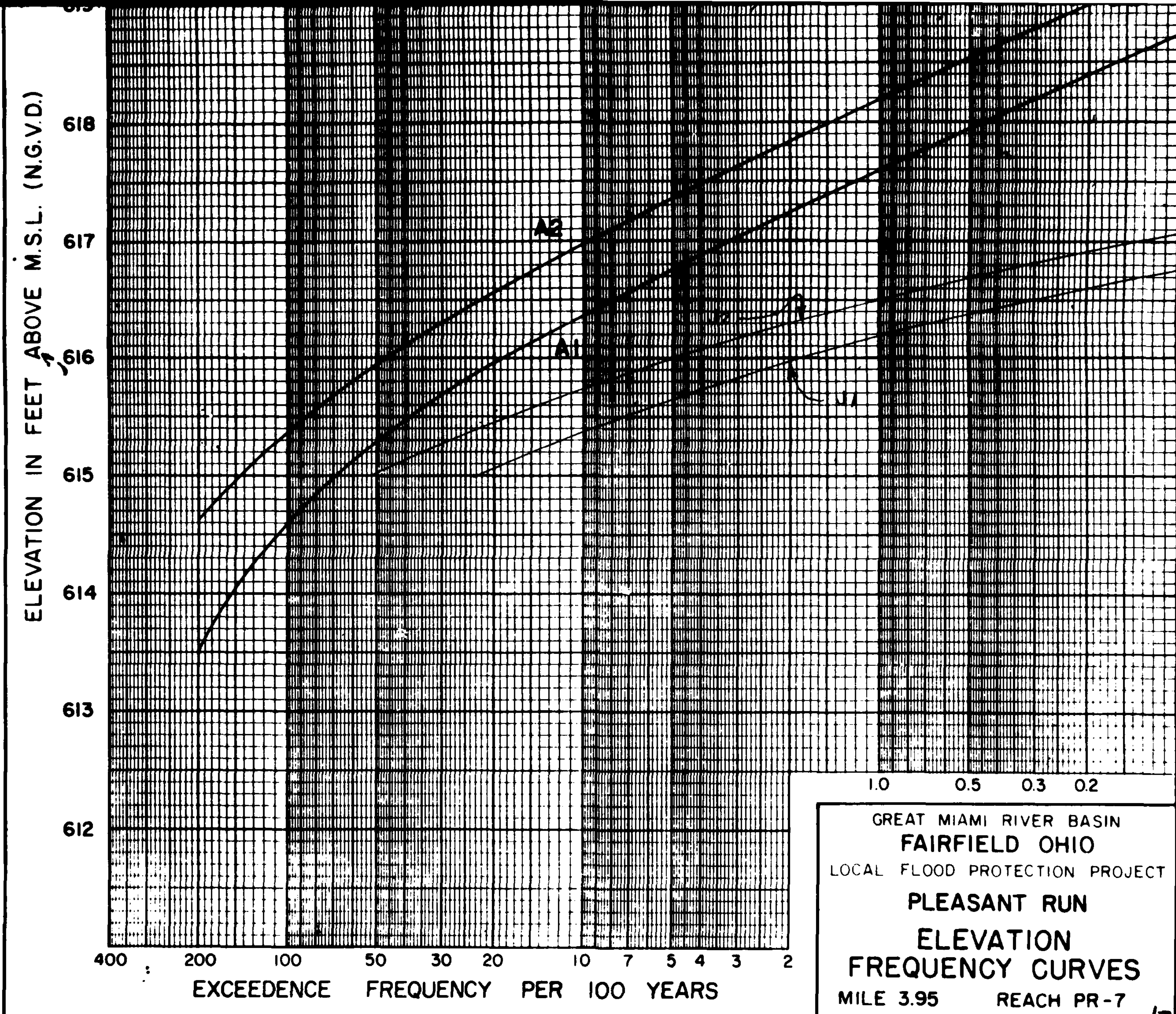
MILE 3.03 REACH PR-6

ORLED-H APRIL 1981

Approved by ___ ___ Transmitted to ______ on ______ 1981

PLATE D-31

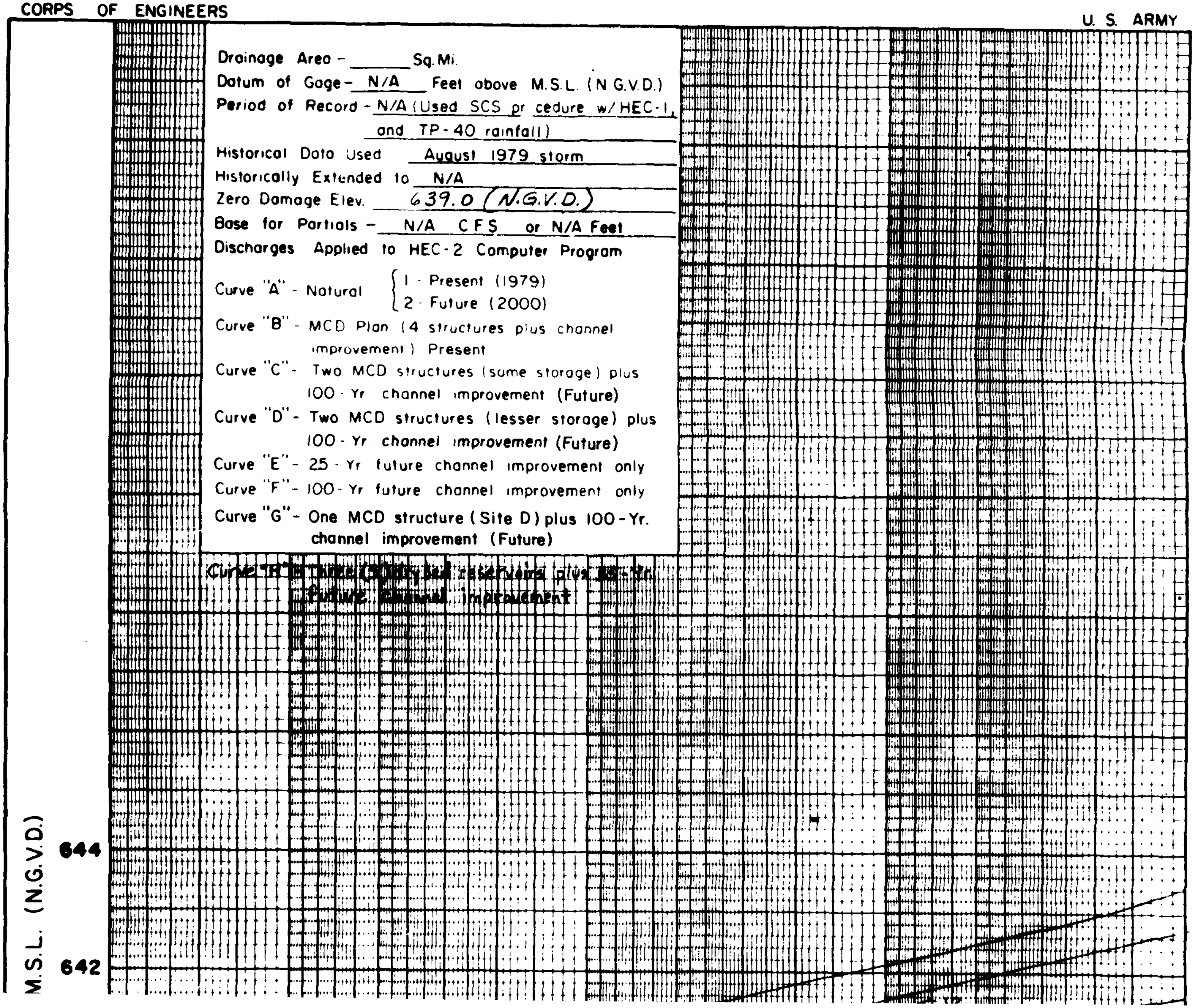

Drainage Area - ______ Sq. Mi.
Datum of Gage - N/A Feet above M.S.L. (N.G.V.D.)
Period of Record - N/A (Used SCS procedure w/ HEC-1, and TP-40 rainfall.)
Historical Data Used August 1979 storm
Historically Extended to N/A
Zero Damage Elev. 616.0 (N.G.V.D.)
Base for Partials - N/A C.F.S. or N/A Feet
Discharges Applied to HEC-2 Computer Program
Curve "A" - Natural { 1 - Present (1979) / 2 - Future (2000)
Curve "B" - MCD Plan (4 structures plus channel improvement) Present
Curve "C" - Two MCD structures (same storage) plus 100-Yr. channel improvement (Future)
Curve "D" - Two MCD structures (lesser storage) plus 100-Yr. channel improvement (Future)
Curve "E" - 25-Yr. future channel improvement only
Curve "F" - 100-Yr. future channel improvement only
Curve "H" - Three (3) drybed reservoirs plus 35-Yr. future Channel Improvement.
620
619
618
617
BOVE M.S.L. (N.G.V.D.)
A2



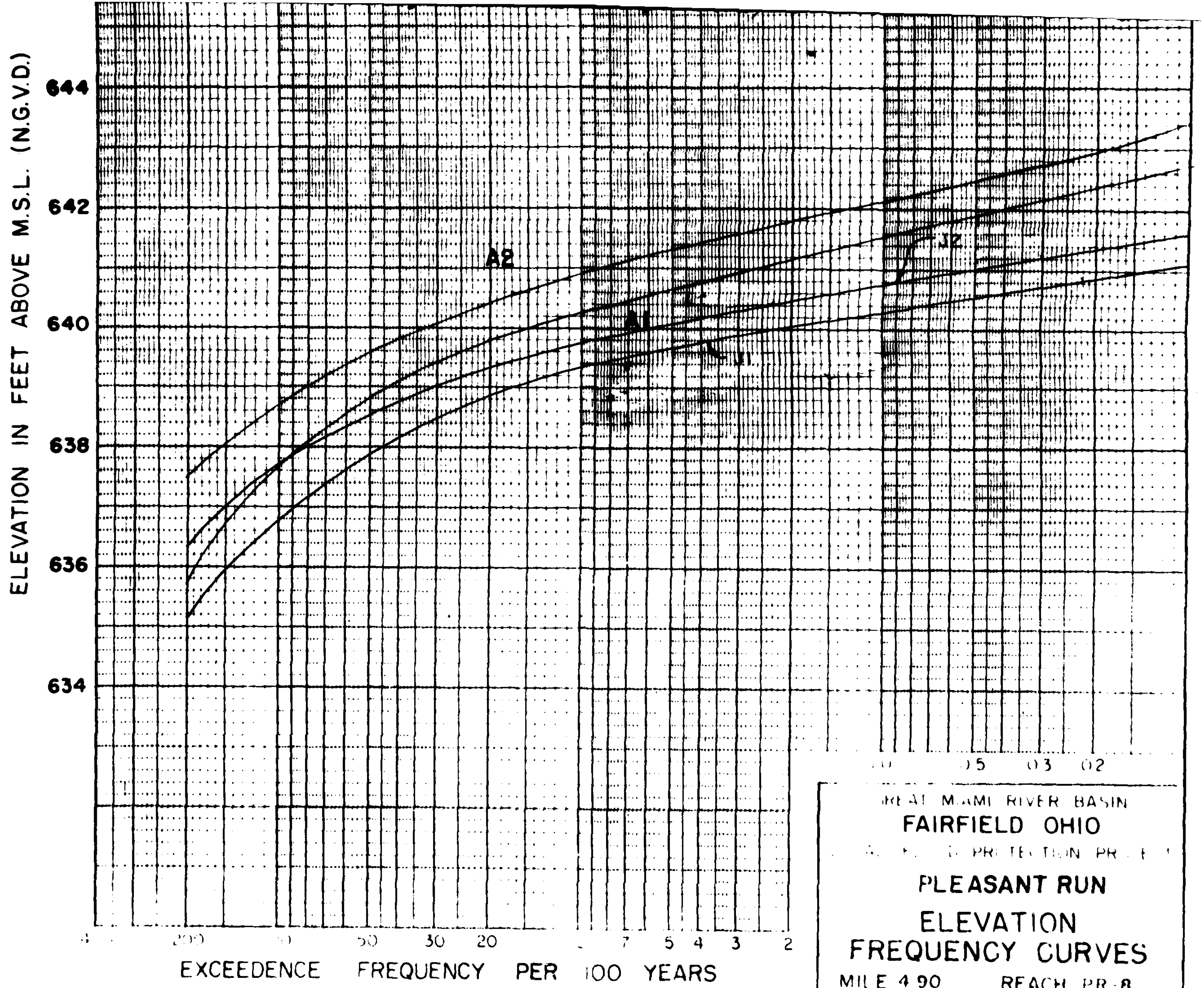
GREAT MIAMI RIVER BASIN
FAIRFIELD OHIO
LOCAL FLOOD PROTECTION PROJECT
PLEASANT RUN
ELEVATION
FREQUENCY CURVES
MILE 3.95 REACH PR-7
ORLED-H APRIL 1980 1-

Approved by ___ ___ Transmitted to ______ on ______ 1981

PLATE D-32



CORPS OF ENGINEERS
U. S. ARMY
Drainage Area - ______ Sq. Mi.
Datum of Gage - N/A Feet above M.S.L. (N.G.V.D.)
Period of Record - N/A (Used SCS pr cedure w/HEC-1, and TP-40 rainfall)
Historical Data Used August 1979 storm
Historically Extended to N/A
Zero Damage Elev. 639.0 (N.G.V.D.)
Base for Partials - N/A CFS or N/A Feet
Discharges Applied to HEC-2 Computer Program
Curve "A" - Natural { 1 - Present (1979) 2 - Future (2000)
Curve "B" - MCD Plan (4 structures plus channel improvement) Present
Curve "C" - Two MCD structures (some storage) plus 100-Yr channel improvement (Future)
Curve "D" - Two MCD structures (lesser storage) plus 100-Yr. channel improvement (Future)
Curve "E" - 25-Yr future channel improvement only
Curve "F" - 100-Yr future channel improvement only
Curve "G" - One MCD structure (Site D) plus 100-Yr. channel improvement (Future)
Curve "H" - Three (3) dry bed reservoirs plus
future channel improvement
644
642
M.S.L. (N.G.V.D.)



GREAT MIAMI RIVER BASIN
FAIRFIELD OHIO

PLEASANT RUN
ELEVATION
FREQUENCY CURVES

MILE 4.90 REACH PR-8

Approved by Transmitted to on 1981

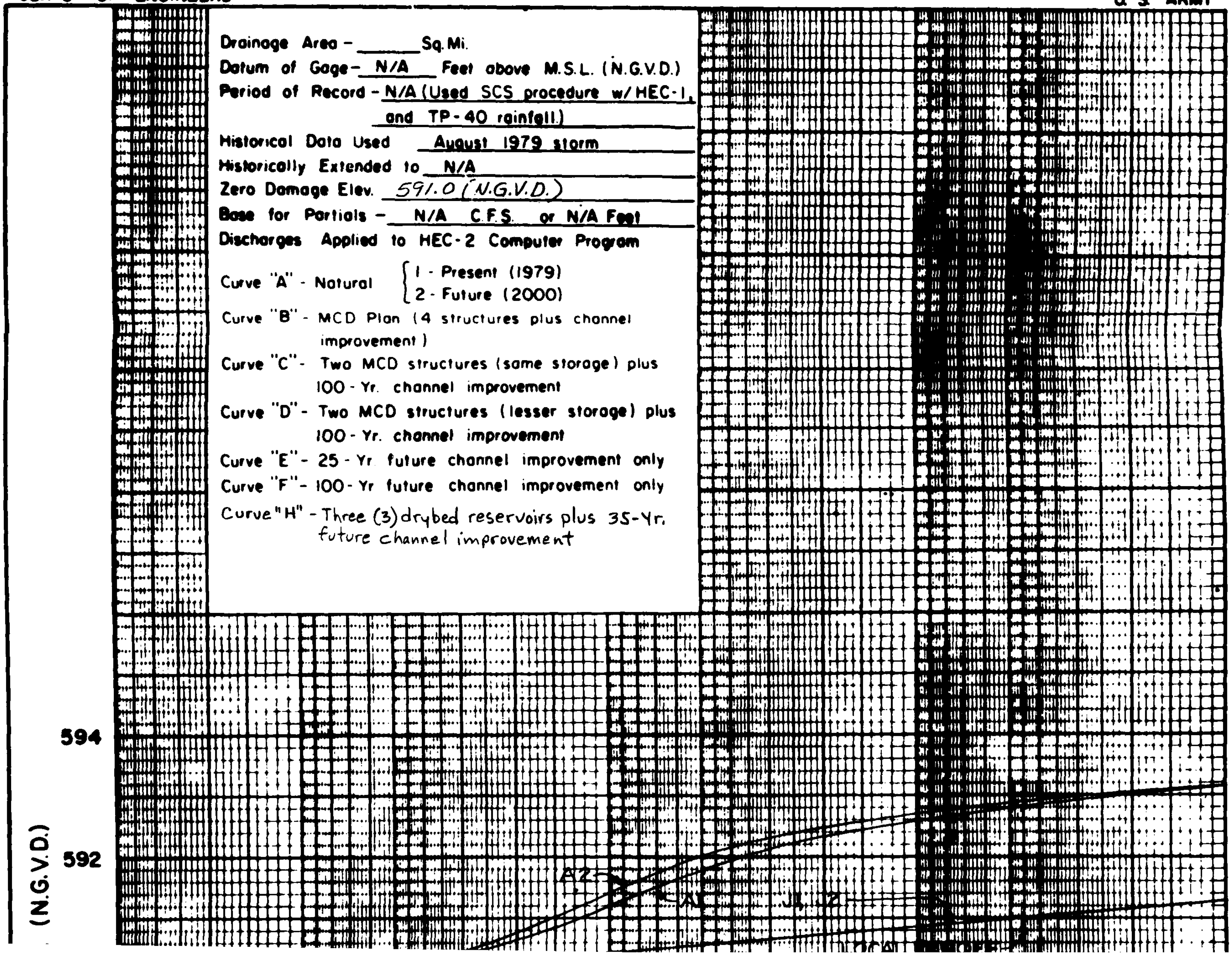
PLATE D-38

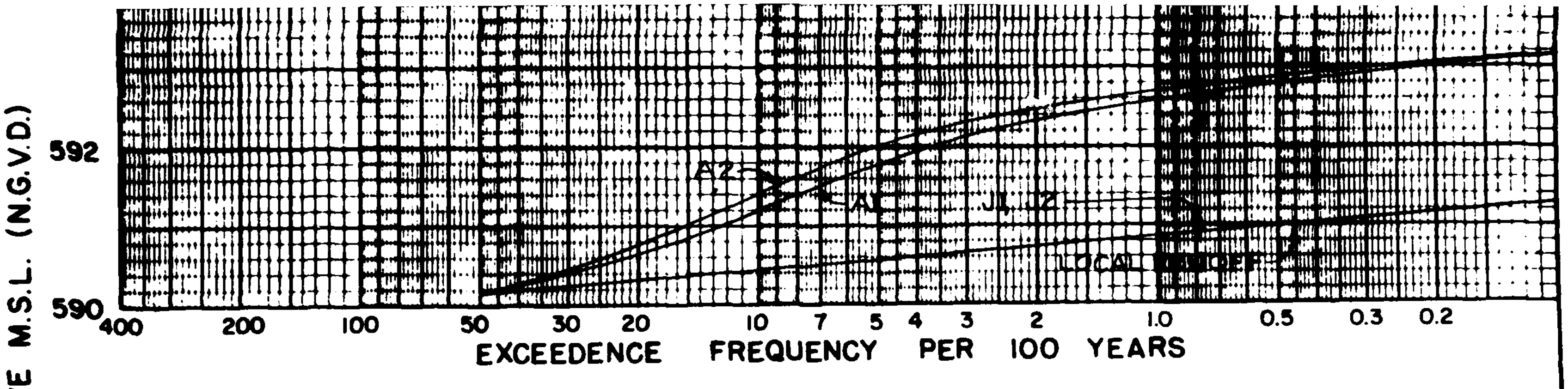
2

CORPS OF ENGINEERS U. S. ARMY

Drainage Area - ______ Sq. Mi.
Datum of Gage - N/A Feet above M.S.L. (N.G.V.D.)
Period of Record - N/A (Used SCS procedure w/HEC-1, and TP-40 rainfall)
Historical Data Used August 1979 storm
Historically Extended to N/A
Zero Damage Elev. 591.0 (N.G.V.D.)
Base for Partials - N/A C.F.S. or N/A Feet
Discharges Applied to HEC-2 Computer Program

Curve "A" - Natural { 1 - Present (1979) / 2 - Future (2000) }
Curve "B" - MCD Plan (4 structures plus channel improvement)
Curve "C" - Two MCD structures (same storage) plus 100-Yr. channel improvement
Curve "D" - Two MCD structures (lesser storage) plus 100-Yr. channel improvement
Curve "E" - 25-Yr. future channel improvement only
Curve "F" - 100-Yr future channel improvement only
Curve "H" - Three (3) drybed reservoirs plus 35-Yr. future channel improvement





GREAT MIAMI RIVER BASIN

FAIRFIELD OHIO

LOCAL FLOOD PROTECTION PROJECT

PLEASANT RUN

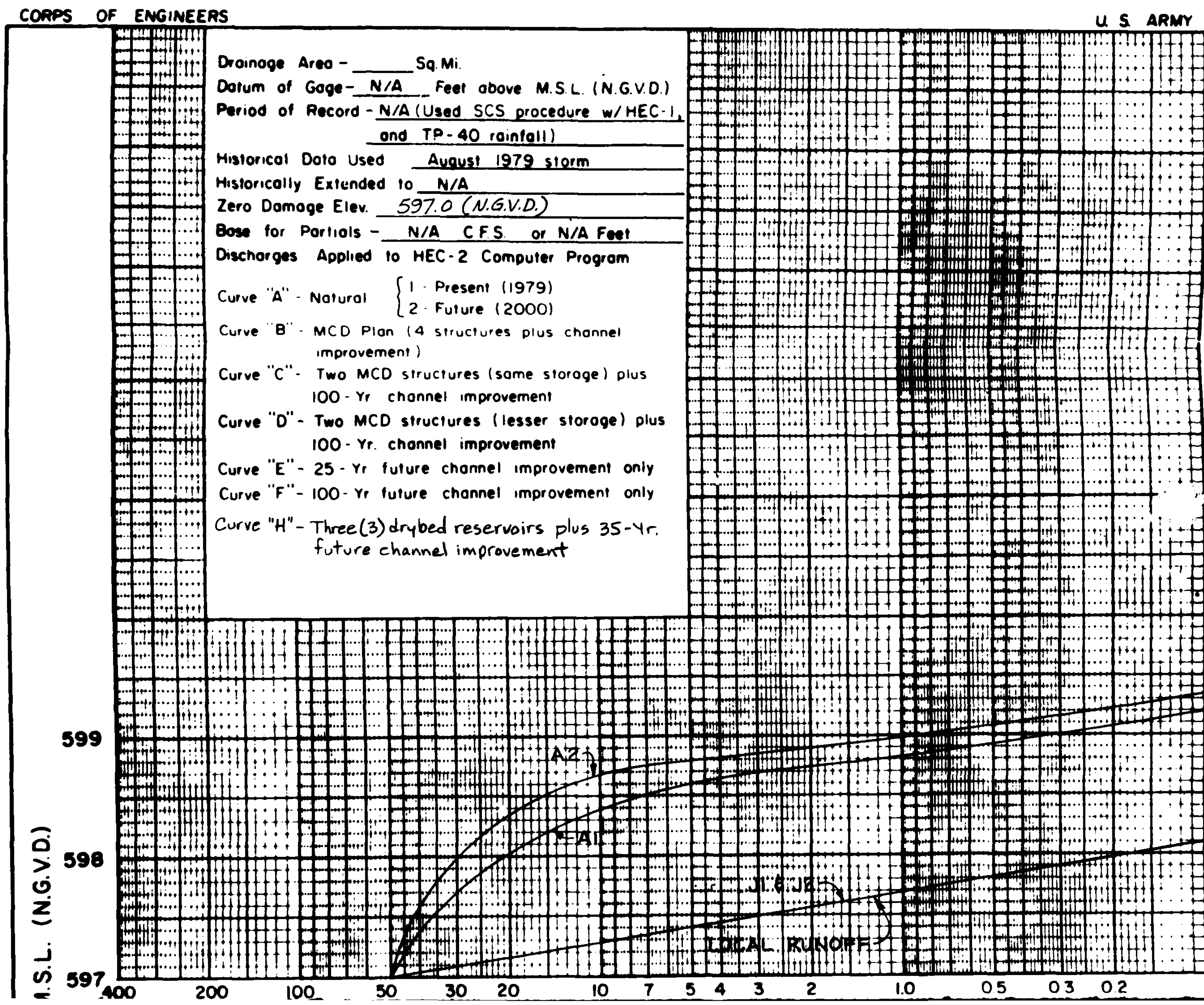
ELEVATION FREQUENCY CURVES

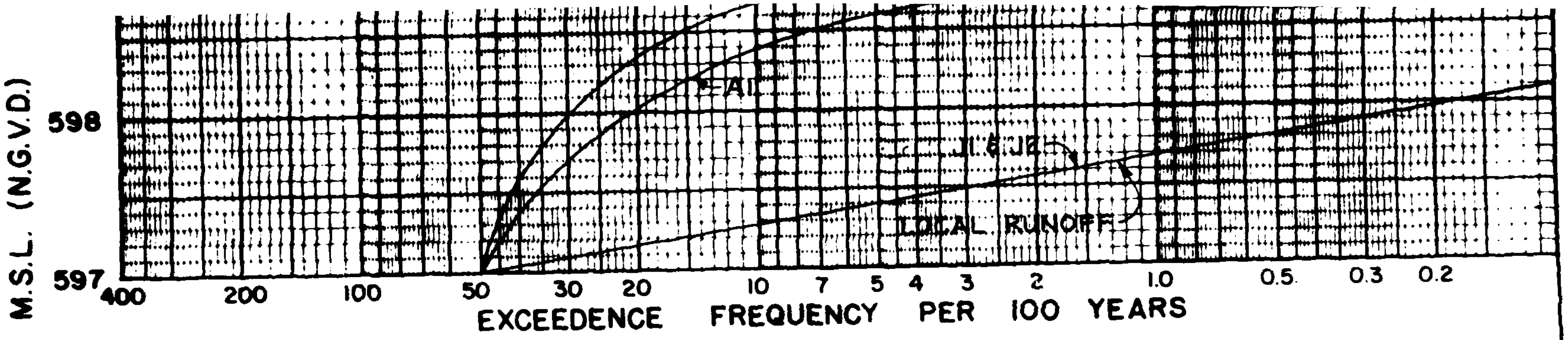
MILE N/A REACH PR-9,13A

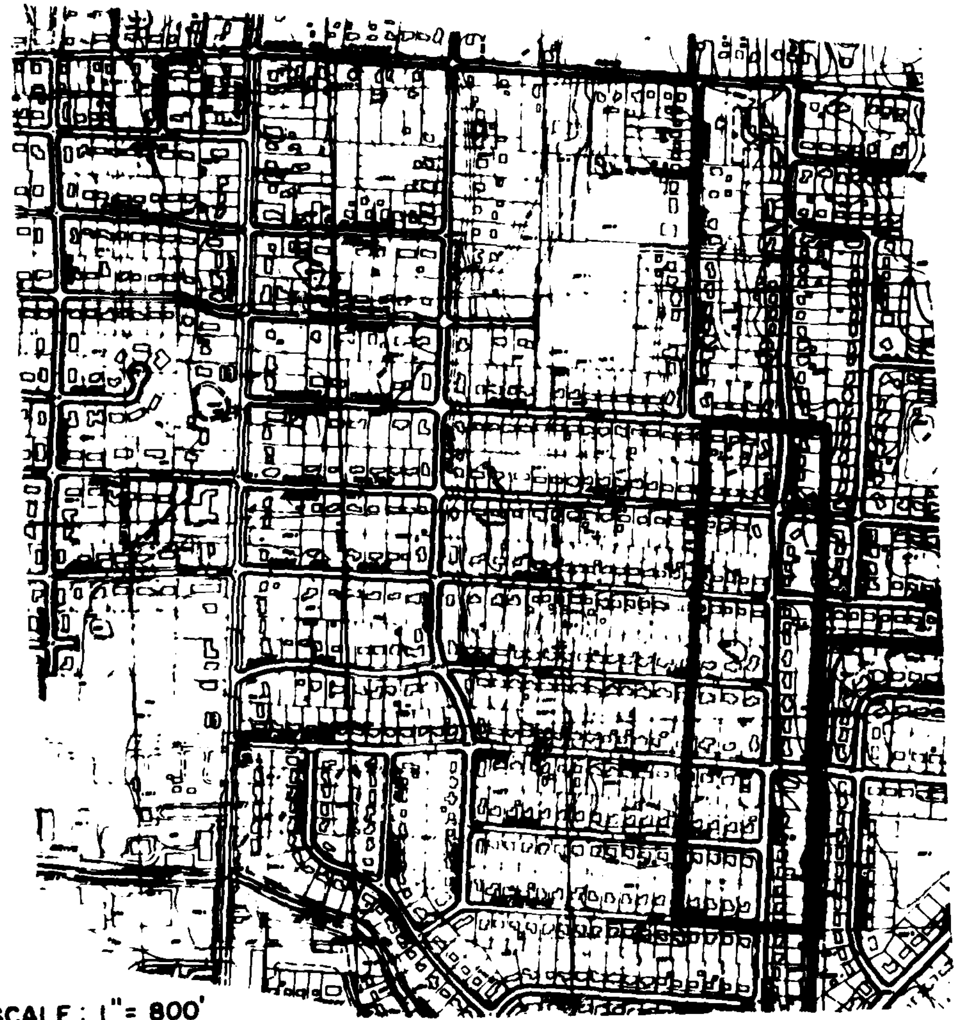
ORLED-H APRIL 1981

Approved by ___ ___ Transmitted to _____ on _____ 1981

PLATE D-34


CORPS OF ENGINEERS
U. S. ARMY
Drainage Area - ______ Sq. Mi.
Datum of Gage - N/A Feet above M.S.L. (N.G.V.D.)
Period of Record - N/A (Used SCS procedure w/ HEC-1, and TP-40 rainfall)
Historical Data Used August 1979 storm
Historically Extended to N/A
Zero Damage Elev. 597.0 (N.G.V.D.)
Base for Partials - N/A C.F.S. or N/A Feet
Discharges Applied to HEC-2 Computer Program
Curve "A" - Natural {1 - Present (1979) / 2 - Future (2000)}
Curve "B" - MCD Plan (4 structures plus channel improvement)
Curve "C" - Two MCD structures (same storage) plus 100-Yr channel improvement
Curve "D" - Two MCD structures (lesser storage) plus 100-Yr. channel improvement
Curve "E" - 25-Yr future channel improvement only
Curve "F" - 100-Yr future channel improvement only
Curve "H" - Three (3) drybed reservoirs plus 35-Yr. future channel improvement
A2
A1
J1 & J2
LOCAL RUNOFF
M.S.L. (N.G.V.D.)
599
598
597
400
200
100
50
30
20
10
7
5
4
3
2
1.0
0.5
0.3
0.2





SCALE: 1" = 800'

GREAT MIAMI RIVER BASIN
FAIRFIELD OHIO
LOCAL FLOOD PROTECTION PROJECT
PLEASANT RUN
ELEVATION
FREQUENCY CURVES
MILE N/A REACH PR-10
ORLED-H APRIL 1981

Approved by ____ ____ Transmitted to _____ on _____ 1981

PLATE D-35

2

CORPS OF ENGINEERS

U. S. ARMY

Drainage Area - ______ Sq. Mi.

Datum of Gage - N/A Feet above M.S.L. (N.G.V.D.)

Period of Record - N/A (Used SCS procedure w/ HEC-1, and TP-40 rainfall)

Historical Data Used August 1979 storm

Historically Extended to N/A

Zero Damage Elev. 593.0 (N.G.V.D.)

Base for Partials - N/A C.F.S. or N/A Feet

Discharges Applied to HEC-2 Computer Program

Curve "A" - Natural { 1 - Present (1979) / 2 - Future (2000) }

Curve "B" - MCD Plan (4 structures plus channel improvement)

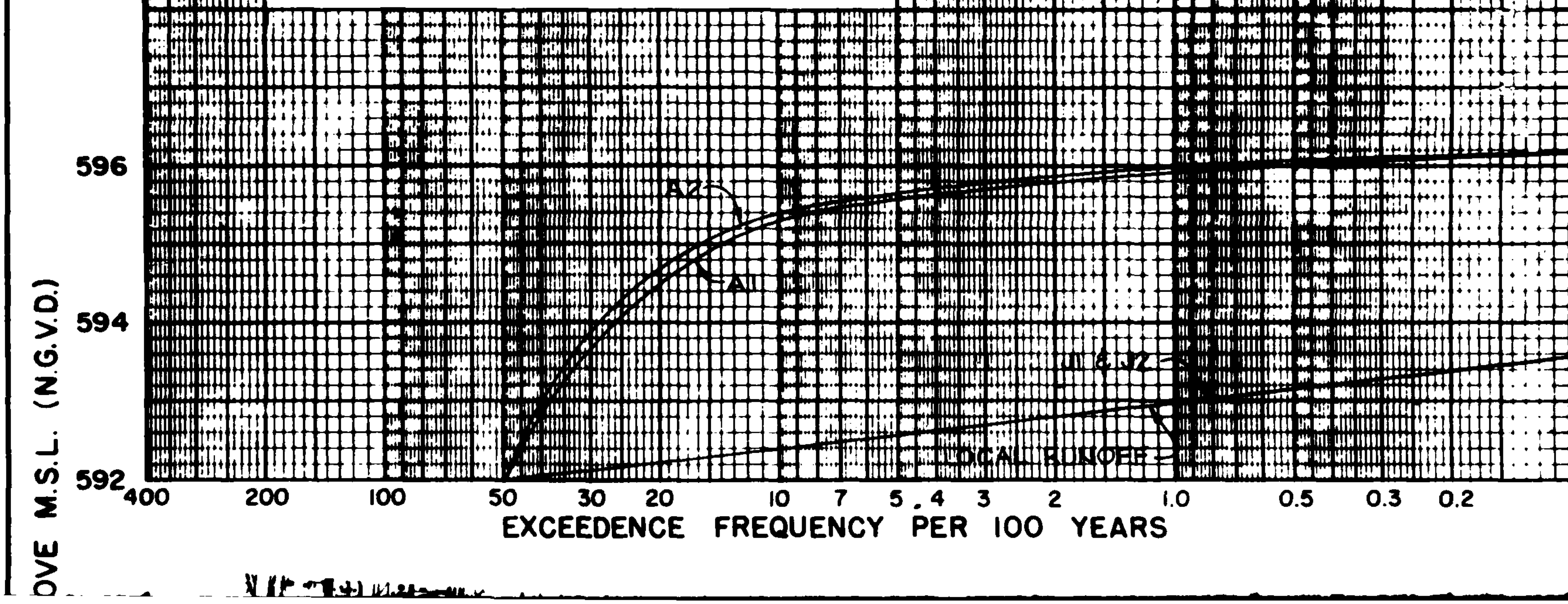
Curve "C" - Two MCD structures (same storage) plus 100-Yr. channel improvement

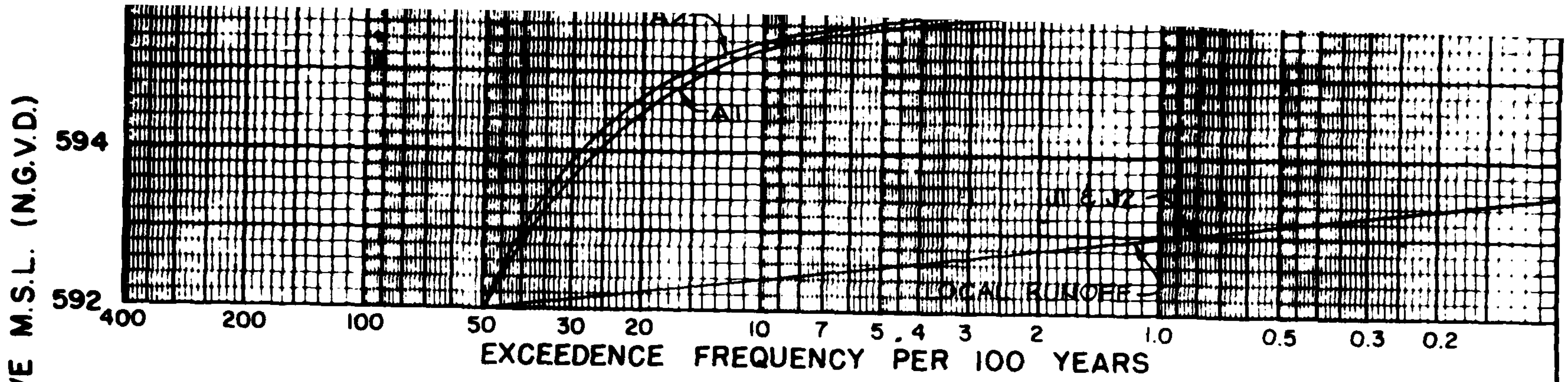
Curve "D" - Two MCD structures (lesser storage) plus 100-Yr. channel improvement

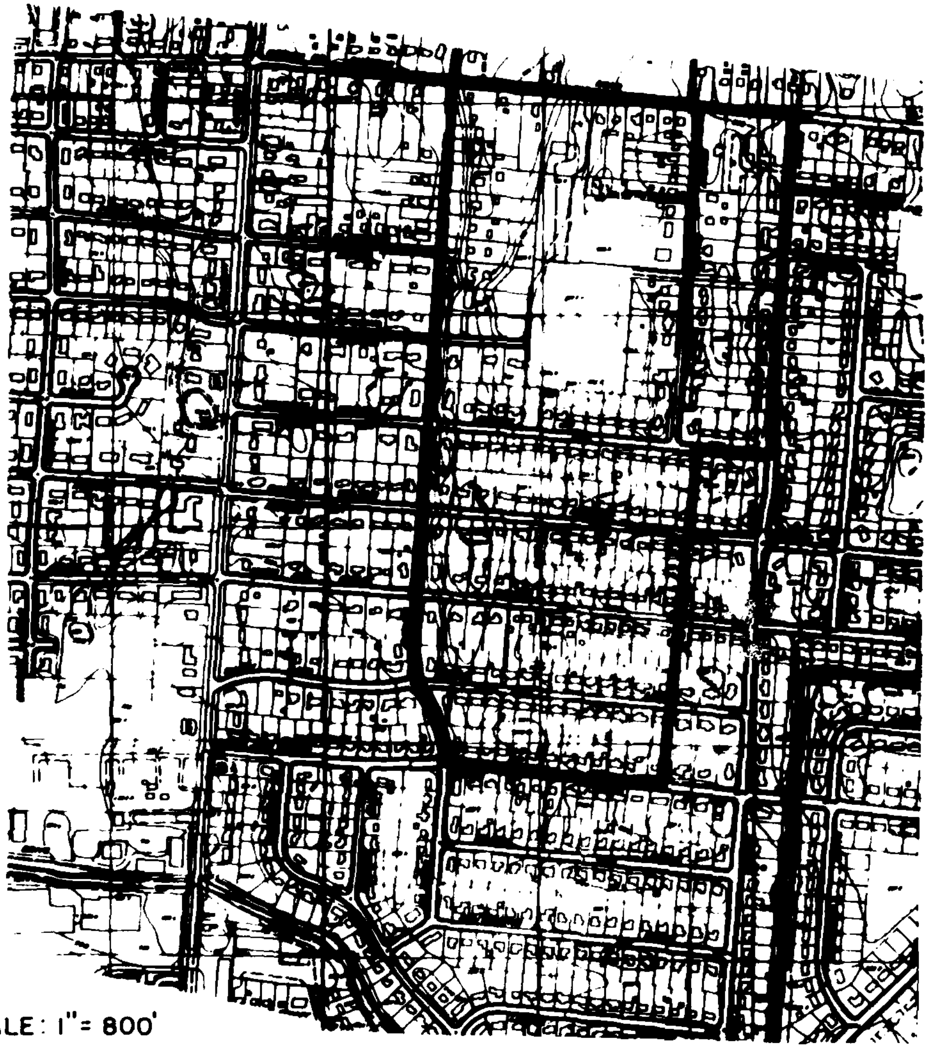
Curve "E" - 25-Yr future channel improvement only

Curve "F" - 100-Yr future channel improvement only

Curve "H" - Three (3) drybed reservoirs plus 35-Yr future channel improvement.







SCALE: 1" = 800'

GREAT MIAMI RIVER BASIN
FAIRFIELD OHIO
LOCAL FLOOD PROTECTION PROJECT
PLEASANT RUN
ELEVATION
FREQUENCY CURVES
MILE N/A REACH PR-11
ORLED-H APRIL 1981

Approved by ___ ___ Transmitted to _____ on _____ 1981

PLATE D-36

Drainage Area - ______ Sq. Mi.
Datum of Gage - N/A Feet above M.S.L. (N.G.V.D.)
Period of Record - N/A (Used SCS procedure w/ HEC-1, and TP-40 rainfall)
Historical Data Used August 1979 storm
Historically Extended to N/A
Zero Damage Elev. 578.0 (N.G.V.D.)
Base for Partials - N/A C.F.S. or N/A Feet
Discharges Applied to HEC-2 Computer Program

Curve "A" - Natural { 1 - Present (1979)
2 - Future (2000) }

Curve "B" - MCD Plan (4 structures plus channel improvement)

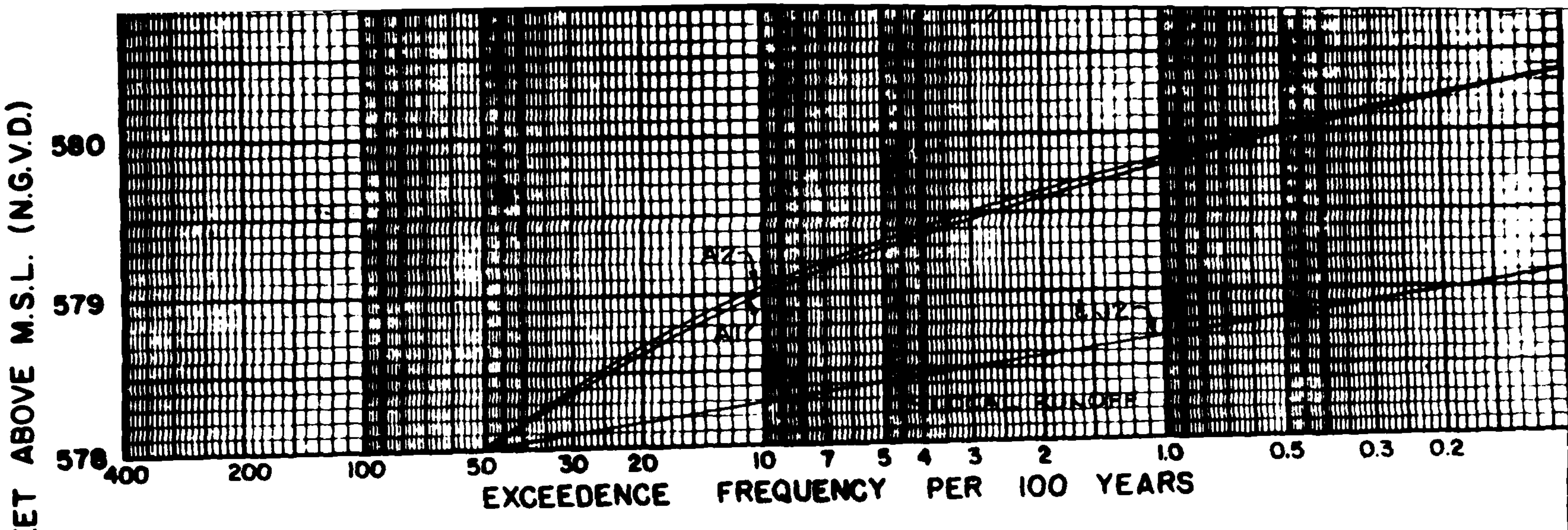
Curve "C" - Two MCD structures (same storage) plus 100-Yr. channel improvement

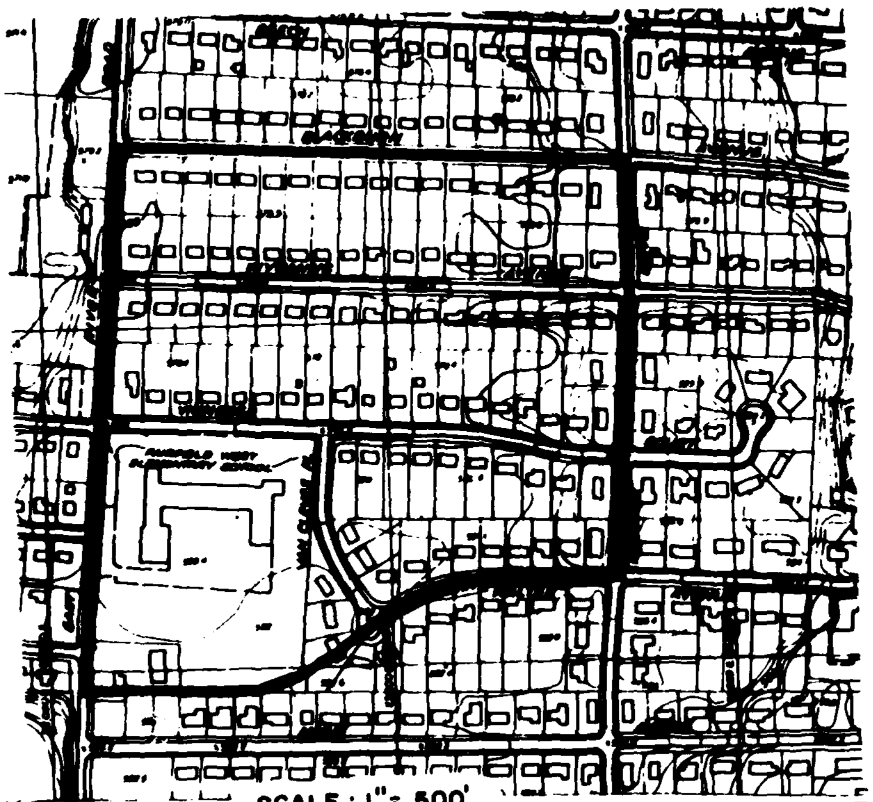
Curve "D" - Two MCD structures (lesser storage) plus 100-Yr. channel improvement

Curve "E" - 25-Yr. future channel improvement only

Curve "F" - 100-Yr. future channel improvement only

Curve "H" - Three (3) drybed reservoirs plus 35-Yr. future channel improvement.





GREAT MIAMI RIVER BASIN
FAIRFIELD OHIO
LOCAL FLOOD PROTECTION PROJECT

PLEASANT RUN

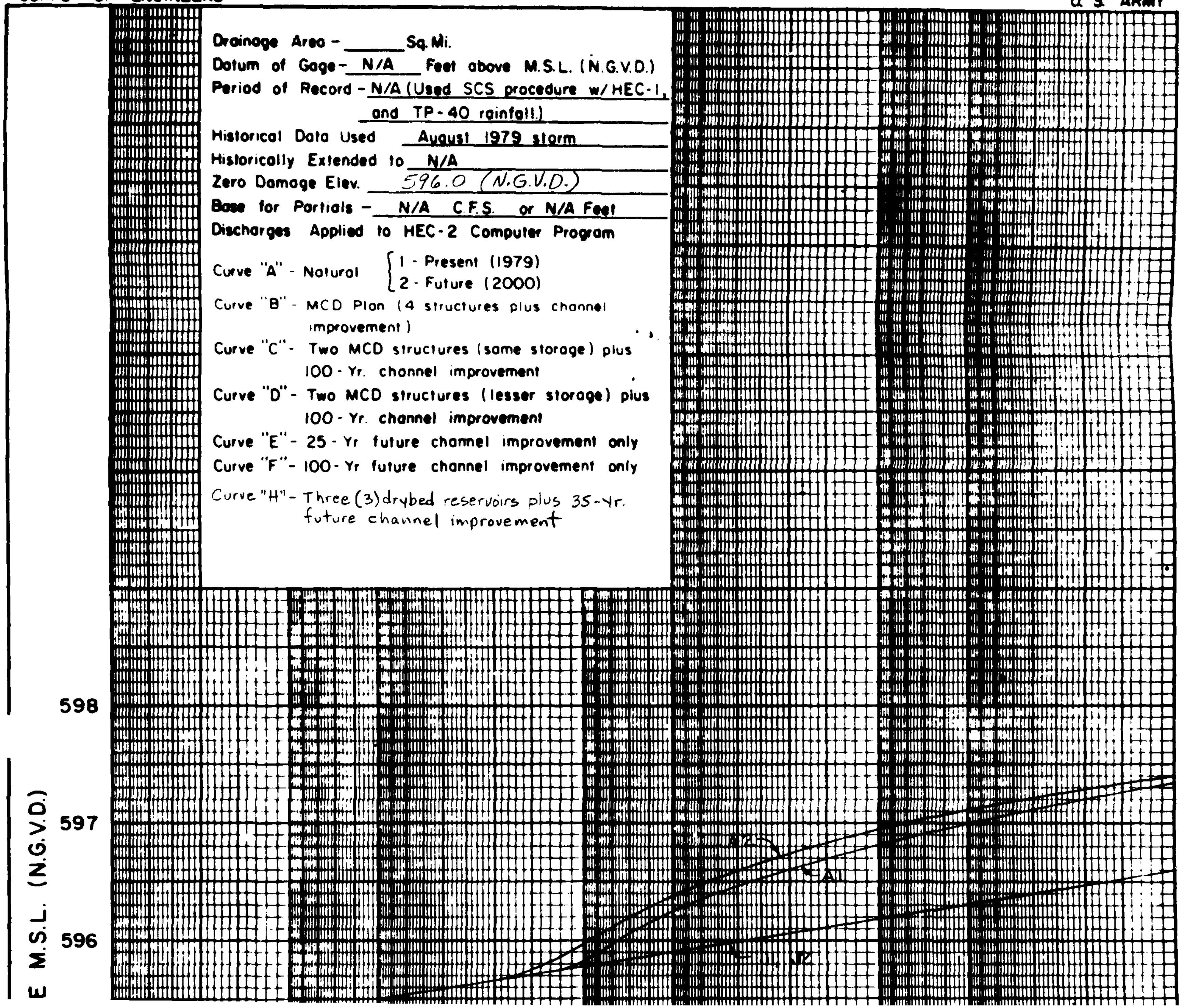
ELEVATION
FREQUENCY CURVES

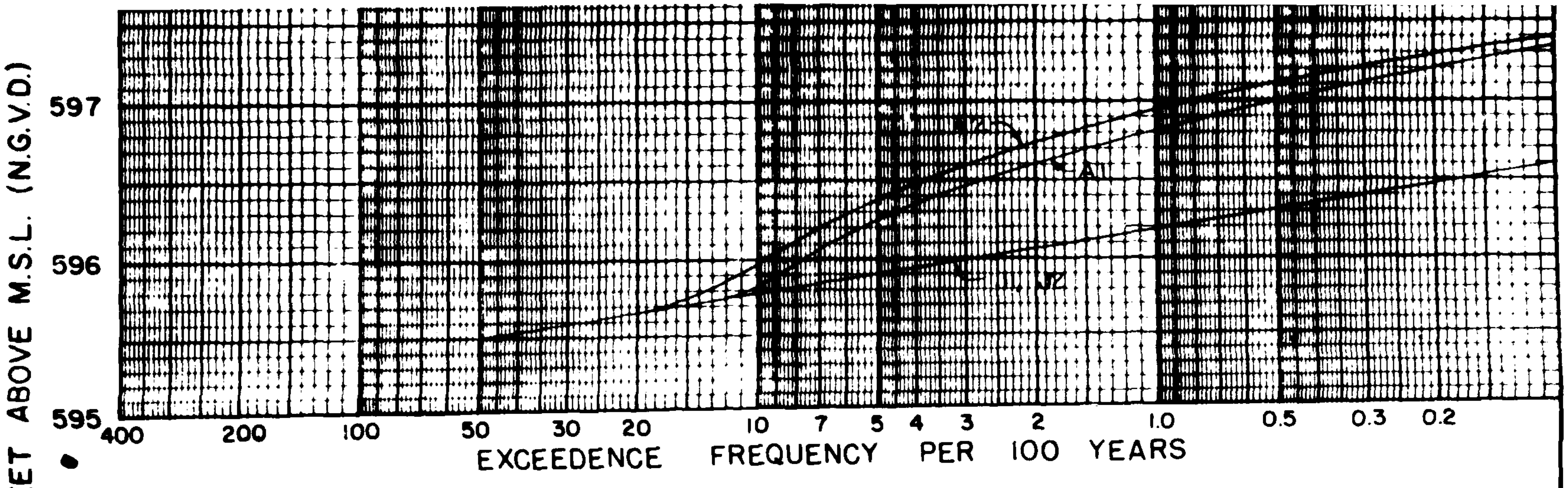
MILE N/A REACH PR-12

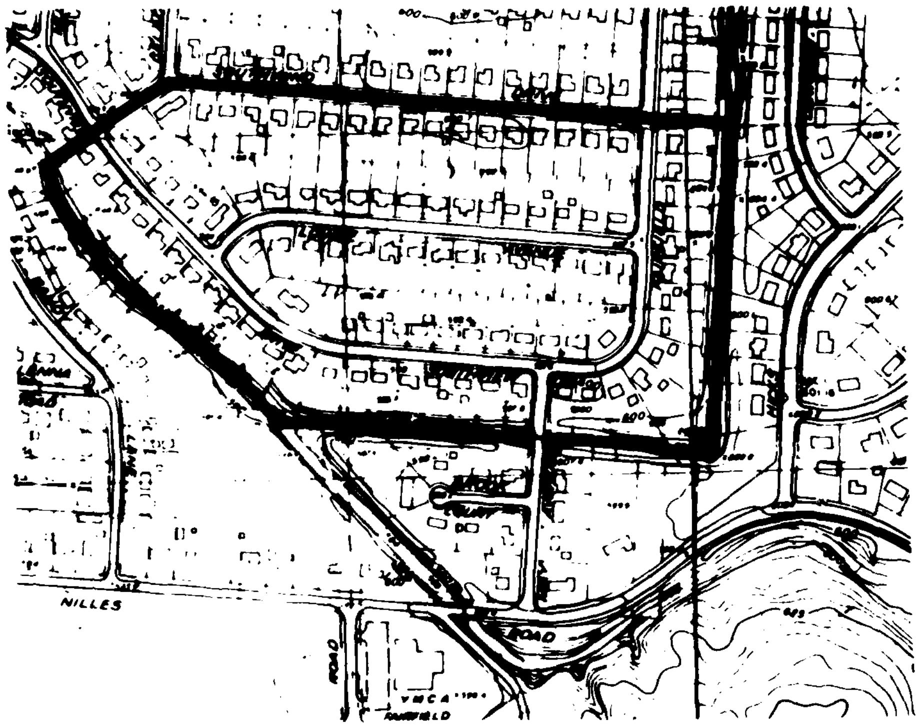
ORLED-H APRIL 1981

Approved by ____ ____ Transmitted to ______ on ______ 1981

CORPS OF ENGINEERS U. S. ARMY







SCALE: 1" = 500'

GREAT MIAMI RIVER BASIN
FAIRFIELD OHIO
LOCAL FLOOD PROTECTION PROJECT

PLEASANT RUN

ELEVATION
FREQUENCY CURVES

MILE N/A REACH PR-13B

ORLED-H APRIL 1981

Approved by ___ ___ Transmitted to ____ on ______ 1981

Drainage Area - ______ Sq. Mi.

Datum of Gage - N/A Feet above M.S.L. (N.G.V.D.)

Period of Record - N/A (Used SCS procedure w/ HEC-1, and TP-40 rainfall.)

Historical Data Used August 1979 storm

Historically Extended to N/A

Zero Damage Elev. 618.0 (N.G.V.D.)

Base for Partials - N/A C.F.S. or N/A Feet

Discharges Applied to HEC-2 Computer Program

Curve "A" - Natural { 1 - Present (1979)
2 - Future (2000)

Curve "B" - MCD Plan (4 structures plus channel improvement) Present

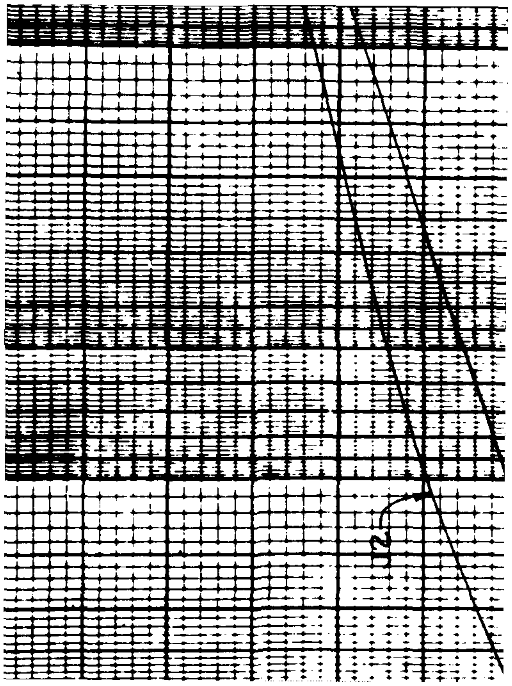
Curve "C" - Two MCD structures (same storage) plus 100-Yr. channel improvement (Future)

Curve "D" - Two MCD structures (lesser storage) plus 100-Yr. channel improvement (Future)

Curve "E" - 25-Yr. future channel improvement only

Curve "F" - 100-Yr. future channel improvement only

Curve "H" - Three (3) drybed reservoirs plus 35-Yr. future channel Improvement.


12

Drainage Area - N/A Sq. Mi.
Datum of Gage - N/A Feet above M.S.L. (N.G.V.D.)
Period of Record - N/A (Used SCS procedure w/ HEC-1, and TP-40 rainfall.)
Historical Data Used August 1979 storm
Historically Extended to N/A
Zero Damage Elev. 619.0 (N.G.V.D.)
Base for Partials - N/A C.F.S. or N/A Feet
Discharges Applied to HEC-2 Computer Program

Curve "A" - Natural { 1 - Present (1979); 2 - Future (2000) }

Curve "B" - MCD Plan (4 structures plus channel improvement) Present

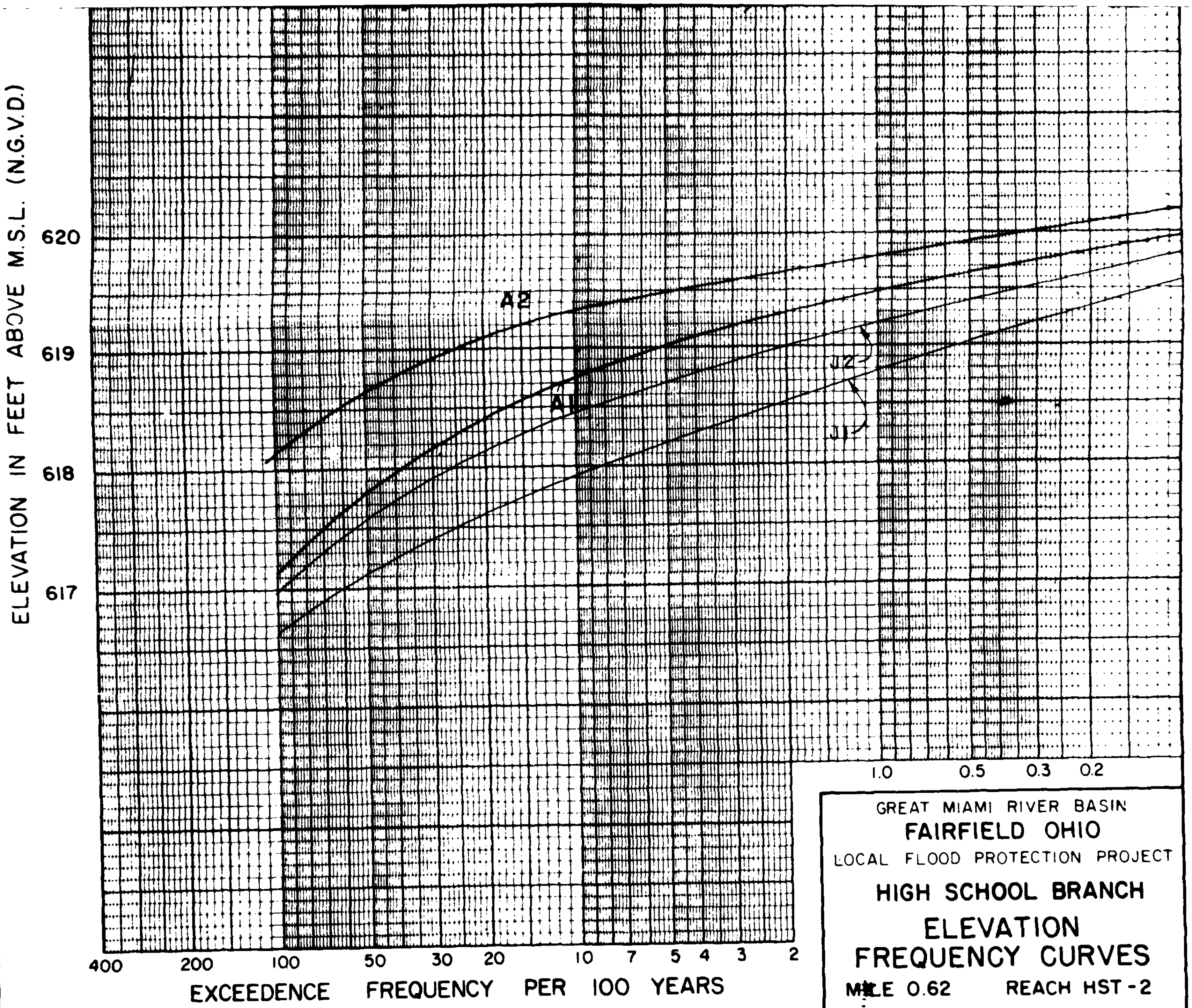
Curve "C" - Two MCD structures (same storage) plus 100-Yr. channel improvement (Future)

Curve "D" - Two MCD structures (lesser storage) plus 100-Yr. channel improvement (Future)

Curve "E" - 25-Yr. future channel improvement only

Curve "F" - 100-Yr. future channel improvement only

Curve "H" - Three (3) drybed reservoirs plus 35-Yr. future channel improvement



GREAT MIAMI RIVER BASIN
FAIRFIELD OHIO
LOCAL FLOOD PROTECTION PROJECT

HIGH SCHOOL BRANCH

ELEVATION
FREQUENCY CURVES

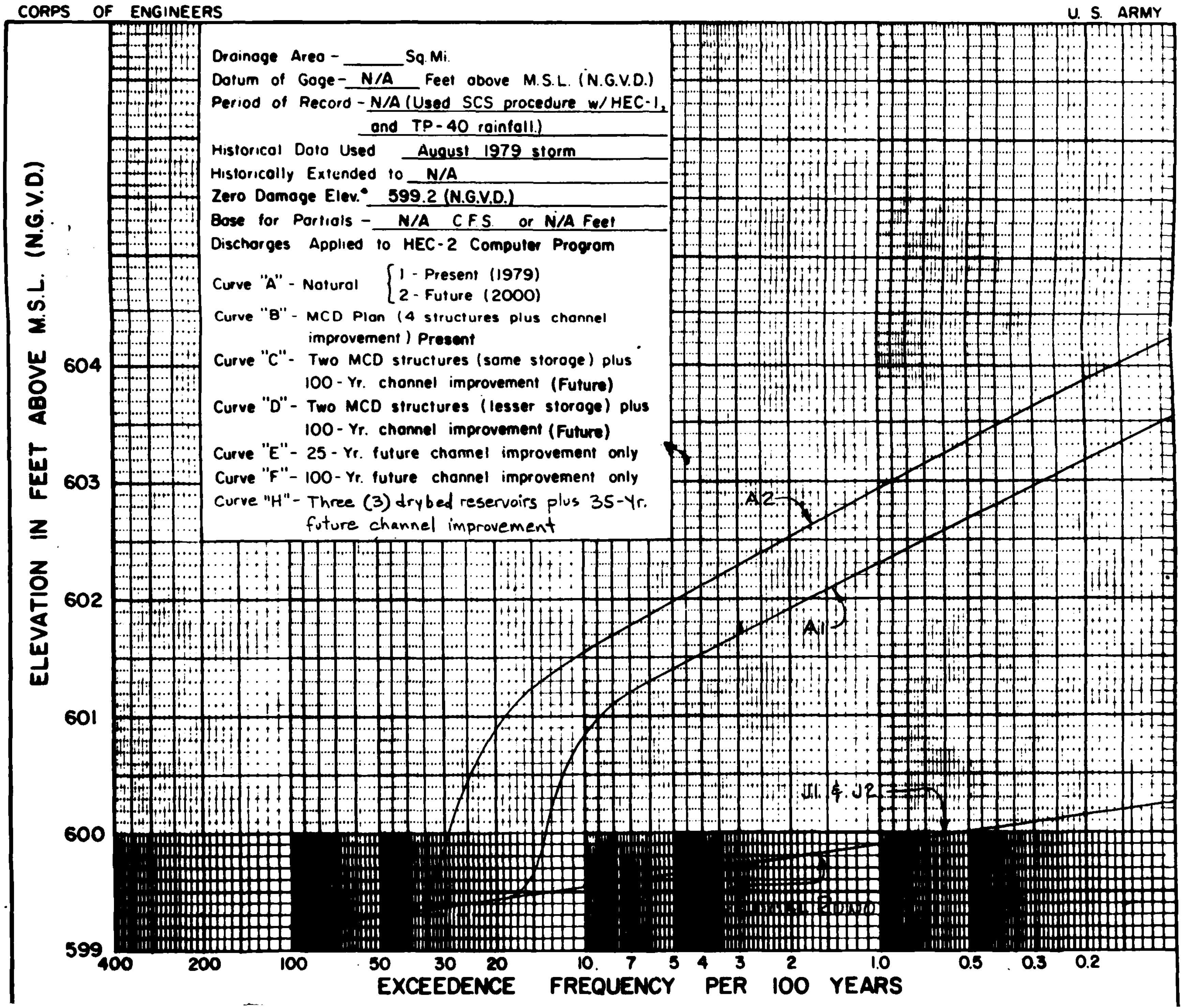
MILE 0.62 REACH HST-2

ORLED-H APRIL 1981

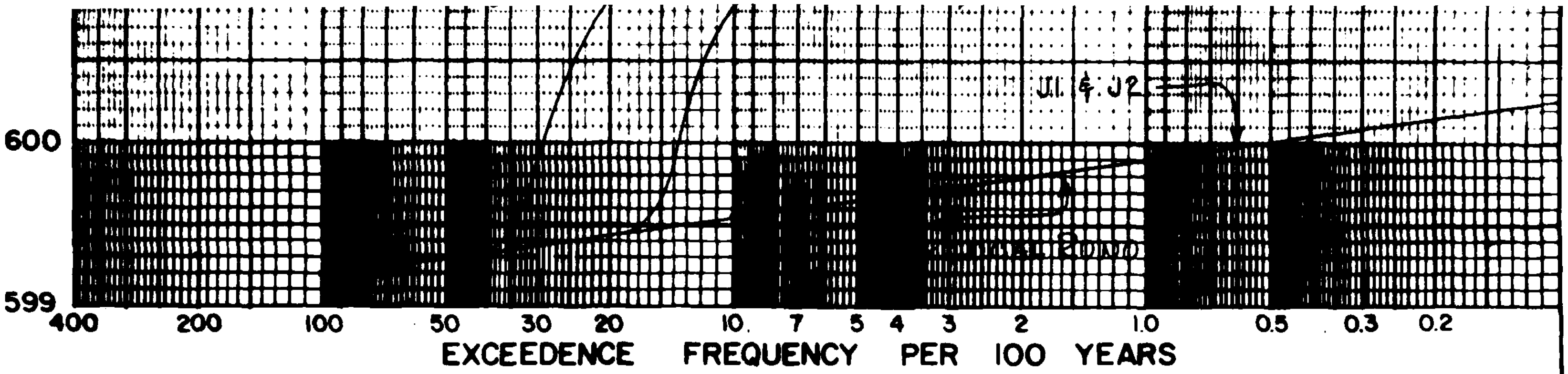
Approved by ___ ___ Transmitted to ______ on ______ 1981

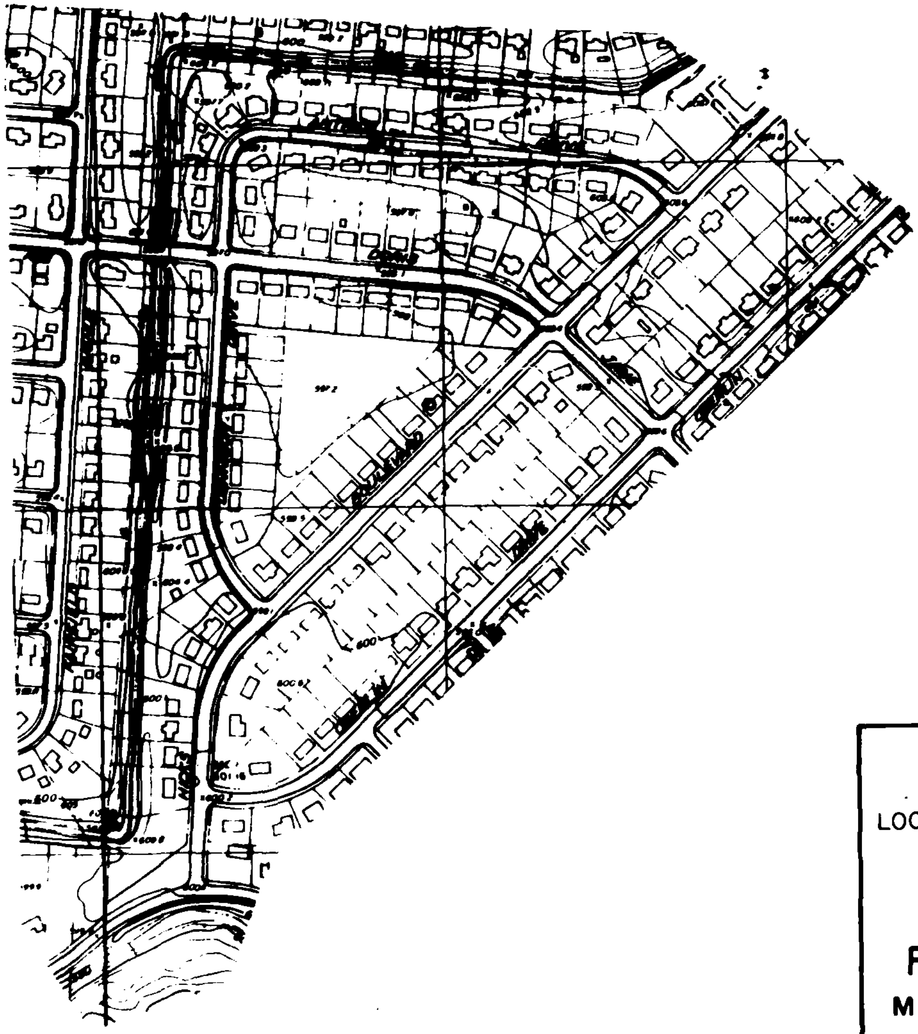
PLATE D-40

2



CORPS OF ENGINEERS
U. S. ARMY
Drainage Area - ______ Sq. Mi.
Datum of Gage - N/A Feet above M.S.L. (N.G.V.D.)
Period of Record - N/A (Used SCS procedure w/ HEC-1, and TP-40 rainfall.)
Historical Data Used August 1979 storm
Historically Extended to N/A
Zero Damage Elev.* 599.2 (N.G.V.D.)
Base for Partials - N/A C.F.S. or N/A Feet
Discharges Applied to HEC-2 Computer Program
Curve "A" - Natural { 1 - Present (1979) 2 - Future (2000)
Curve "B" - MCD Plan (4 structures plus channel improvement) Present
Curve "C" - Two MCD structures (same storage) plus 100-Yr. channel improvement (Future)
Curve "D" - Two MCD structures (lesser storage) plus 100-Yr. channel improvement (Future)
Curve "E" - 25-Yr. future channel improvement only
Curve "F" - 100-Yr. future channel improvement only
Curve "H" - Three (3) drybed reservoirs plus 35-Yr. future channel improvement
A2
A1
J1 & J2
ELEVATION IN FEET ABOVE M.S.L. (N.G.V.D.)
604
603
602
601
600
599
400
200
100
50
30
20
10.
7
5
4
3
2
1.0
0.5
0.3
0.2
EXCEEDENCE FREQUENCY PER 100 YEARS





SCALE: 1" = 500'

GREAT MIAMI RIVER BASIN
FAIRFIELD OHIO
LOCAL FLOOD PROTECTION PROJECT

G.M. DITCH

ELEVATION FREQUENCY CURVES

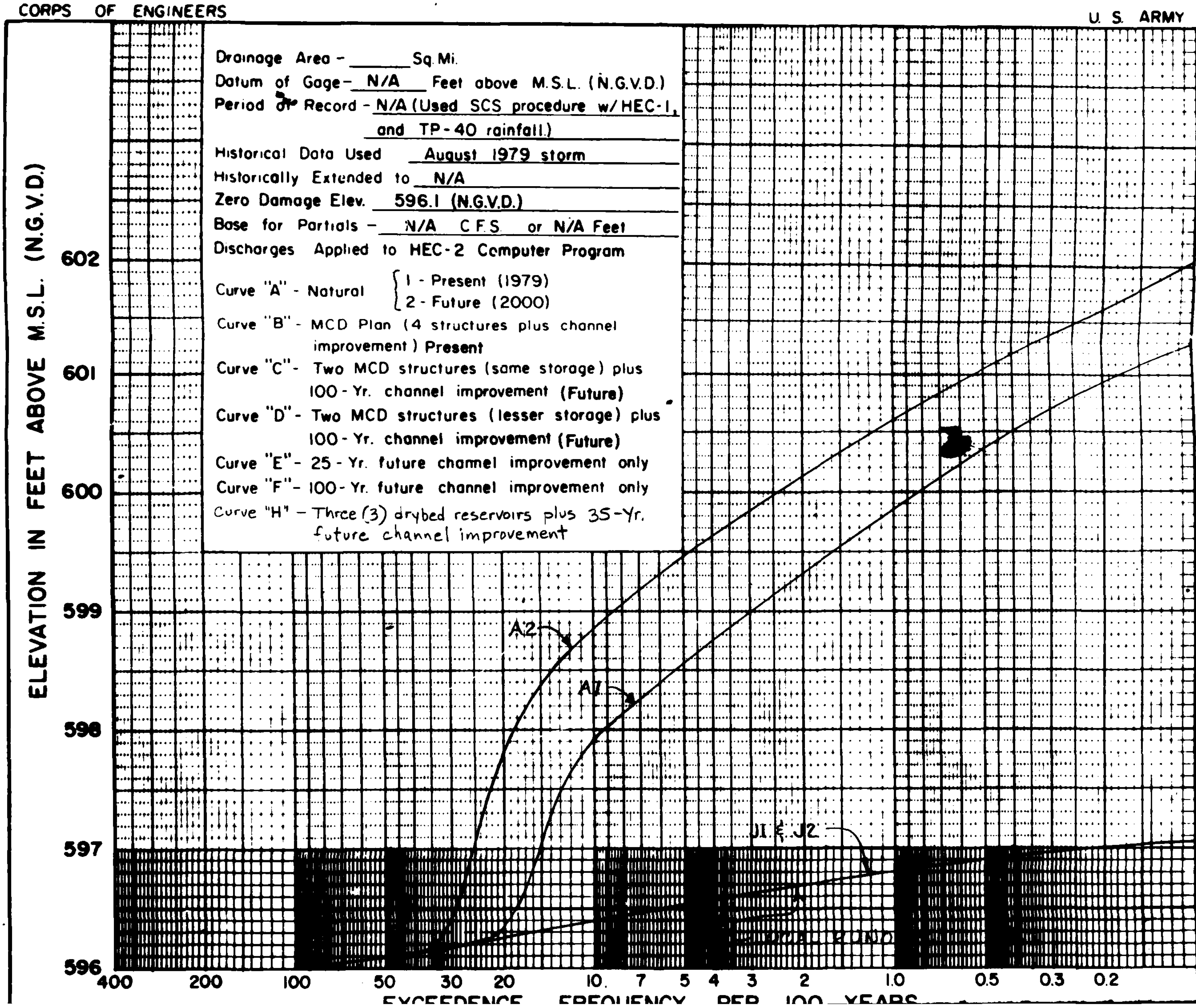
MILE N/A REACH GM-1A

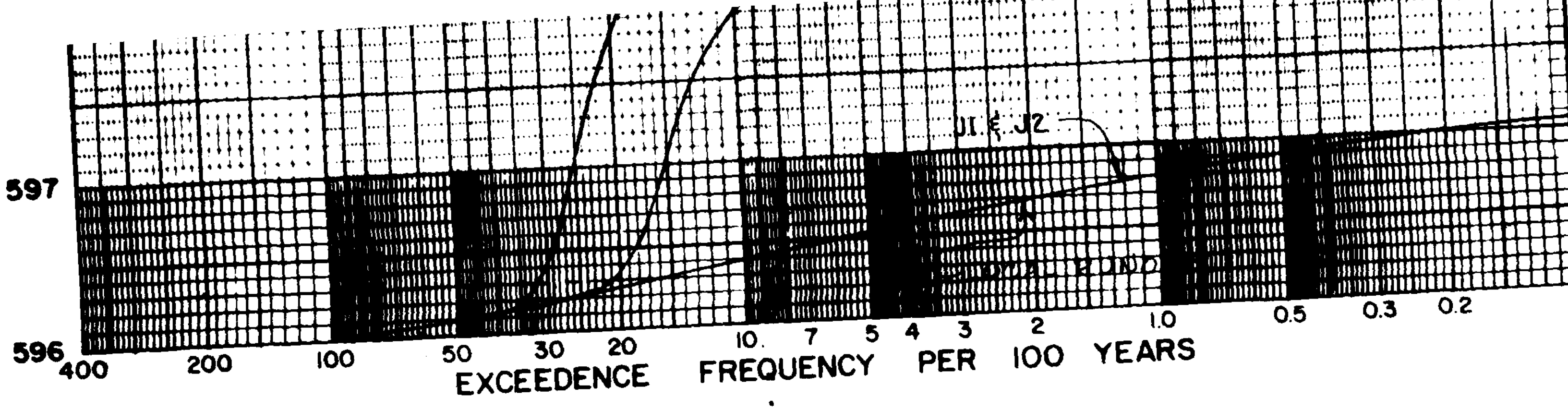
ORLED-H APRIL 1981

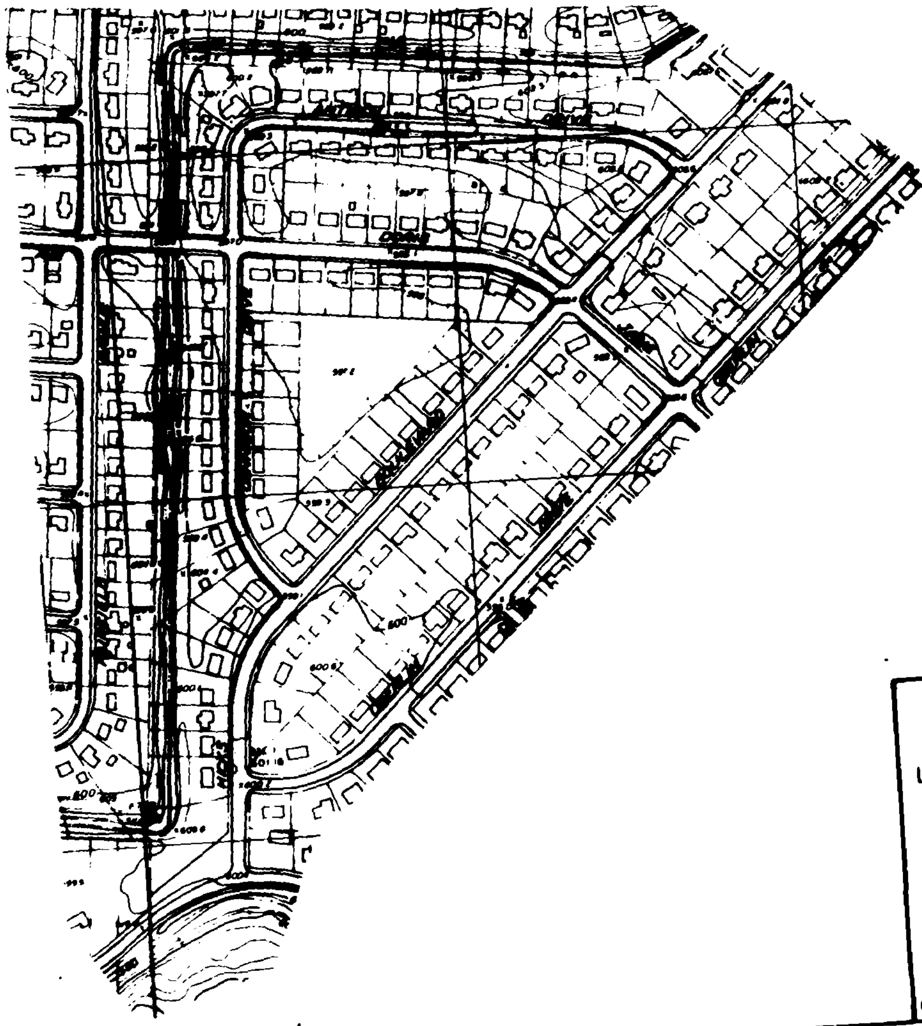
Approved by __ __ Transmitted to _____ on _____ 1981

PLATE D-41

2


CORPS OF ENGINEERS
U. S. ARMY
Drainage Area - ______ Sq. Mi.
Datum of Gage - N/A Feet above M.S.L. (N.G.V.D.)
Period of Record - N/A (Used SCS procedure w/HEC-1, and TP-40 rainfall.)
Historical Data Used August 1979 storm
Historically Extended to N/A
Zero Damage Elev. 596.1 (N.G.V.D.)
Base for Partials - N/A C.F.S. or N/A Feet
Discharges Applied to HEC-2 Computer Program
Curve "A" - Natural { 1 - Present (1979) 2 - Future (2000)
Curve "B" - MCD Plan (4 structures plus channel improvement) Present
Curve "C" - Two MCD structures (same storage) plus 100-Yr. channel improvement (Future)
Curve "D" - Two MCD structures (lesser storage) plus 100-Yr. channel improvement (Future)
Curve "E" - 25-Yr. future channel improvement only
Curve "F" - 100-Yr. future channel improvement only
Curve "H" - Three (3) drybed reservoirs plus 35-Yr. future channel improvement
A2
A1
J1 & J2
ELEVATION IN FEET ABOVE M.S.L. (N.G.V.D.)
602
601
600
599
598
597
596
400
200
100
50
30
20
10.
7
5
4
3
2
1.0
0.5
0.3
0.2
EXCEEDENCE FREQUENCY PER 100 YEARS





SCALE: 1" = 500'

2

GREAT MIAMI RIVER BASIN
FAIRFIELD OHIO
LOCAL FLOOD PROTECTION PROJECT

G.M. DITCH

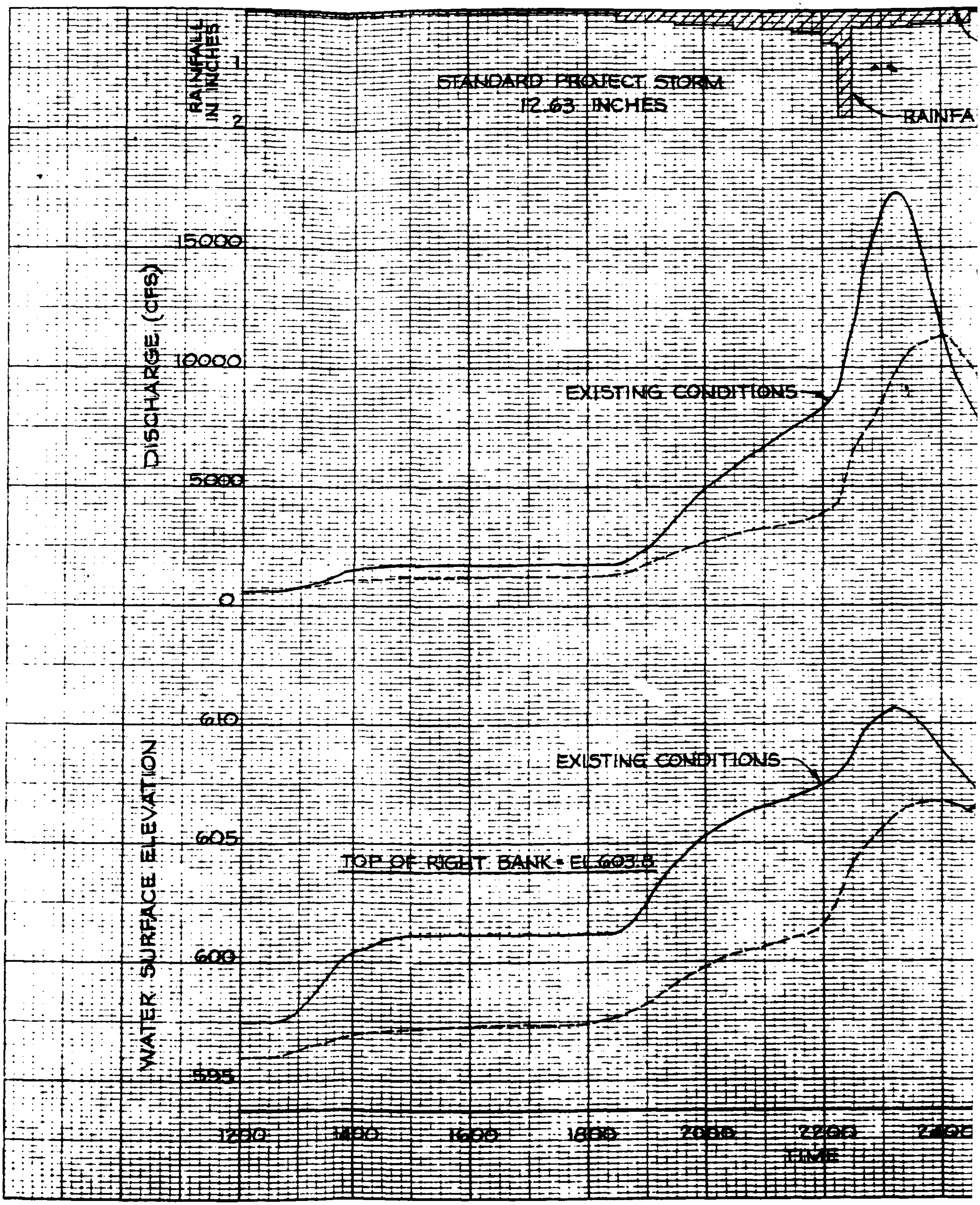
ELEVATION
FREQUENCY CURVES

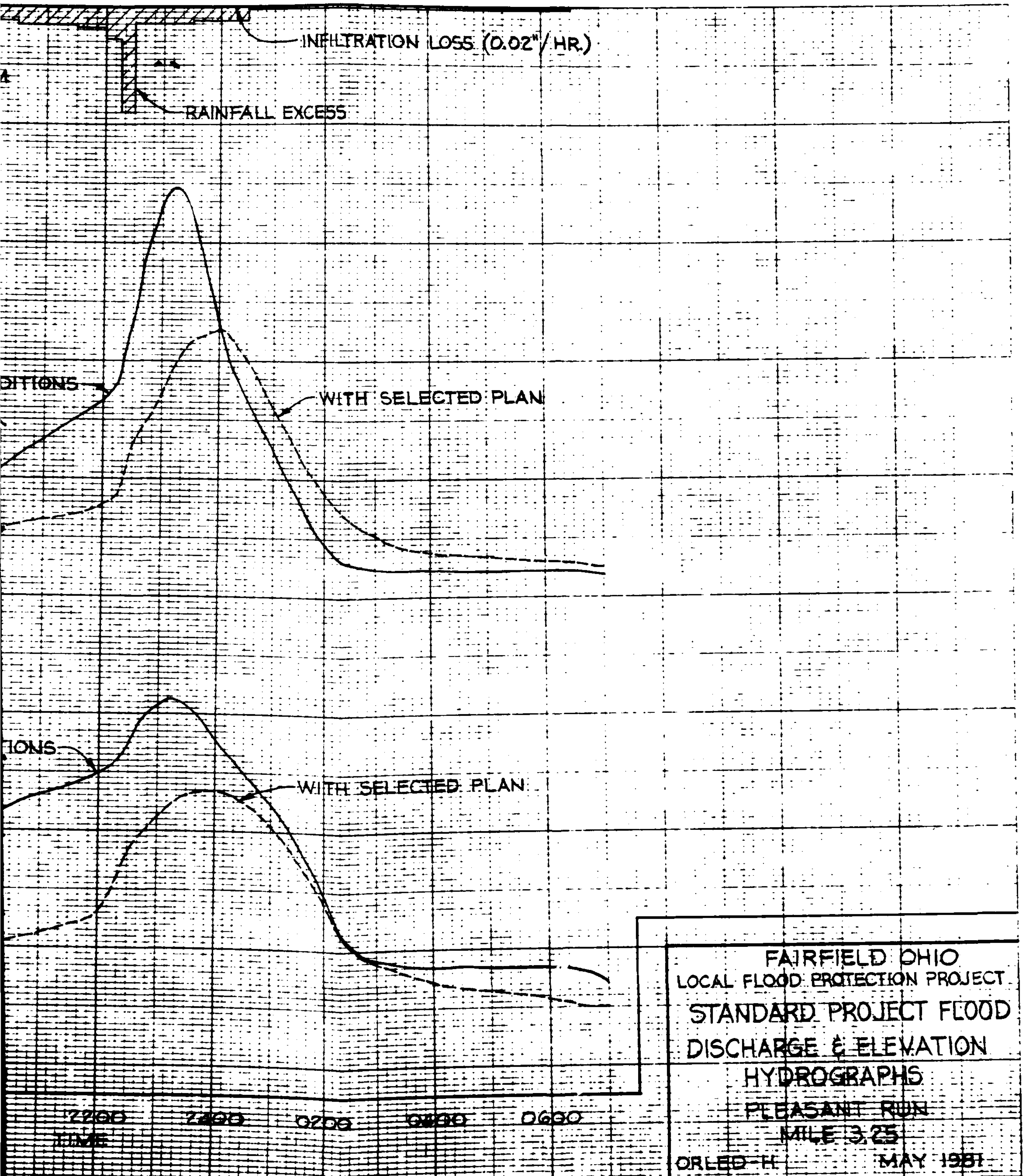
MILE N/A REACH GM-1B

ORLED-H APRIL 1980

Approved by ____ Transmitted to ____ on ____ 1980

PLATE D-42

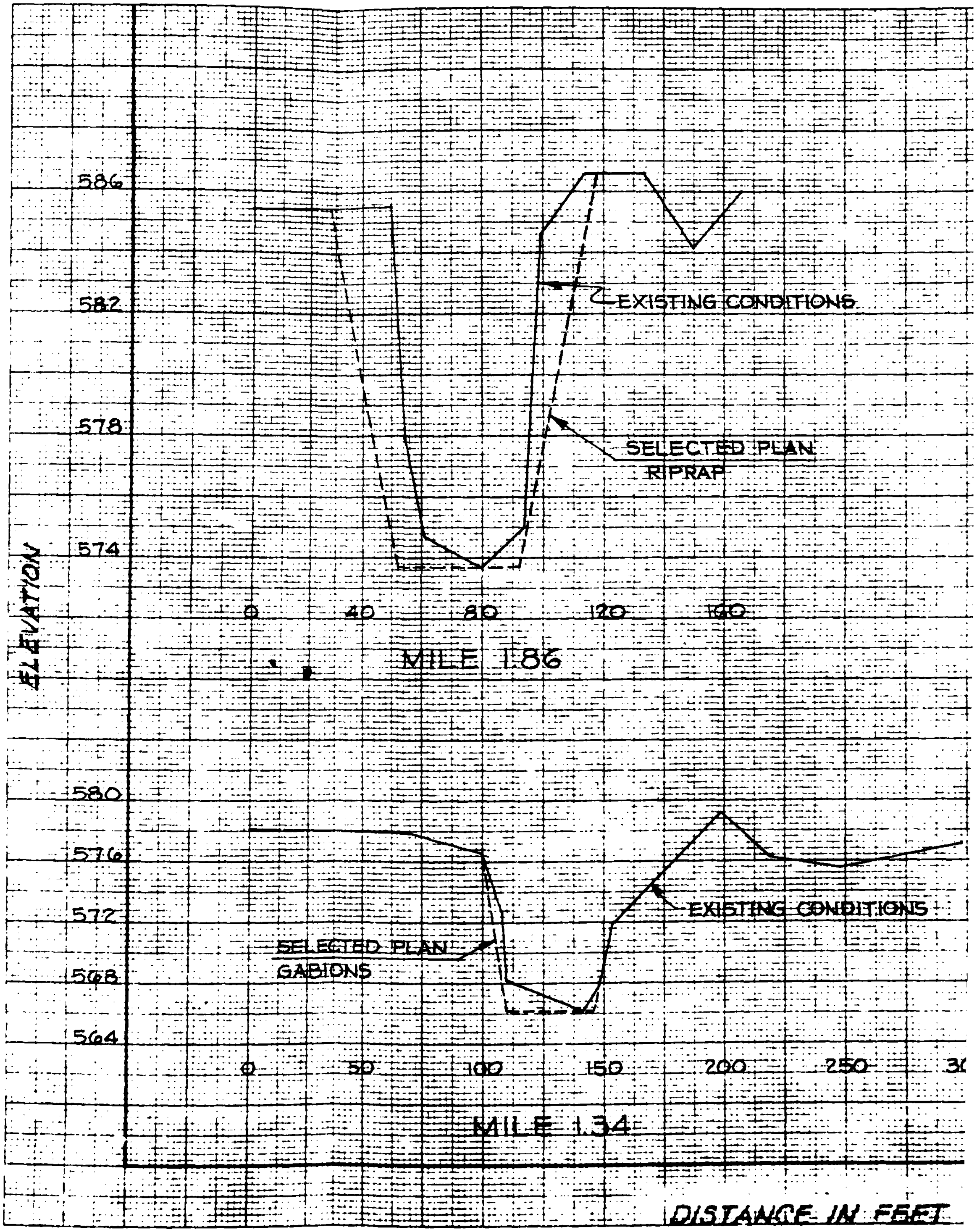

RAINFALL IN INCHES
1
2
STANDARD PROJECT STORM
12.63 INCHES
DISCHARGE (CFS)
15000
10000
5000
0
EXISTING CONDITIONS
WATER SURFACE ELEVATION
610
605
600
595
EXISTING CONDITIONS
TOP OF RIGHT BANK • EL 603.8
1200
1400
1600
1800
2000
2200
TIME



FAIRFIELD OHIO
LOCAL FLOOD PROTECTION PROJECT
STANDARD PROJECT FLOOD
DISCHARGE & ELEVATION
HYDROGRAPHS
PLEASANT RUN
MILE 3.25
ORLED-H MAY 1981

PLATE D-43

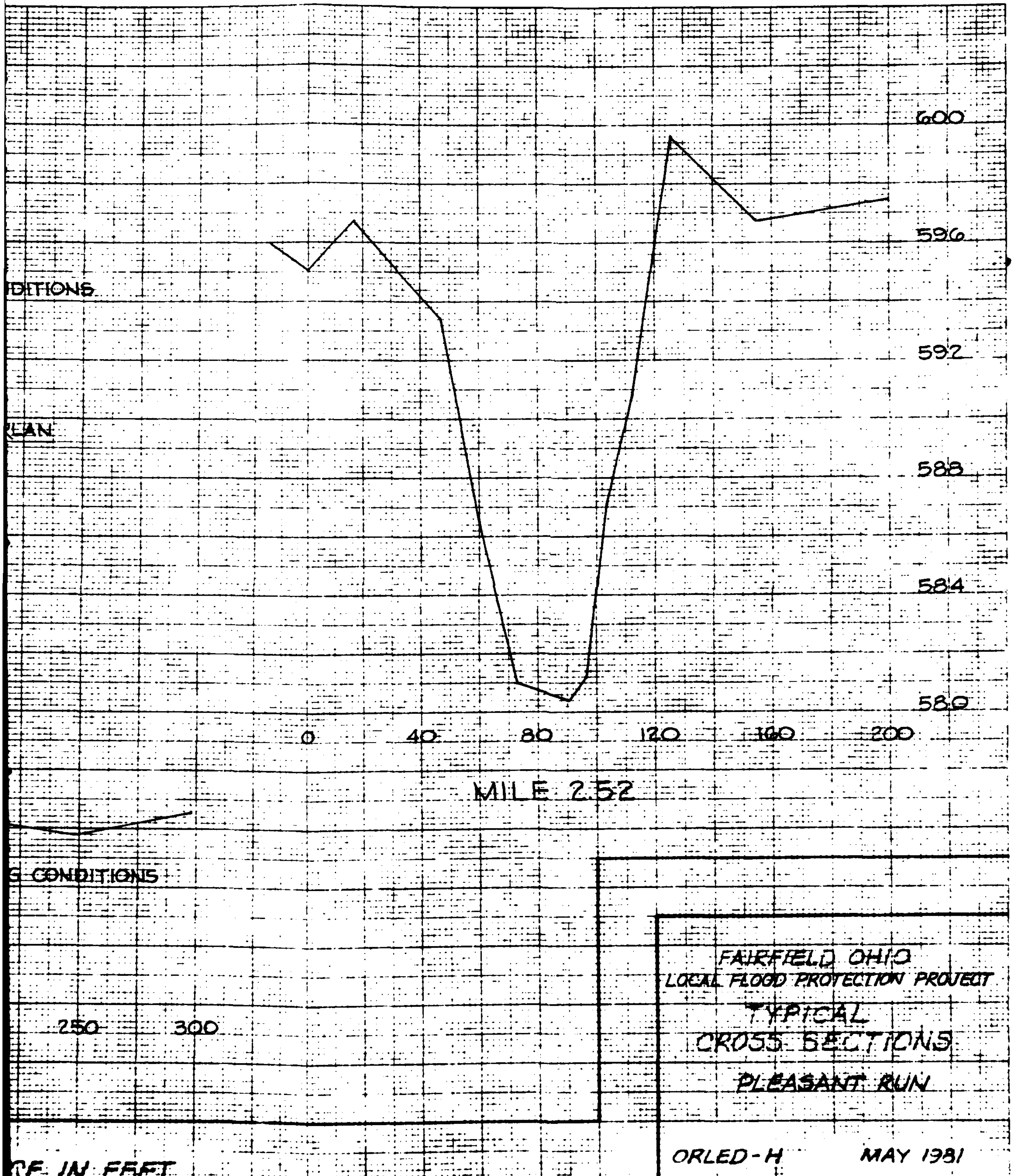
2



47 1323

K•E 10 X 10 TO ½ INCH • 10 X 15 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A.

54



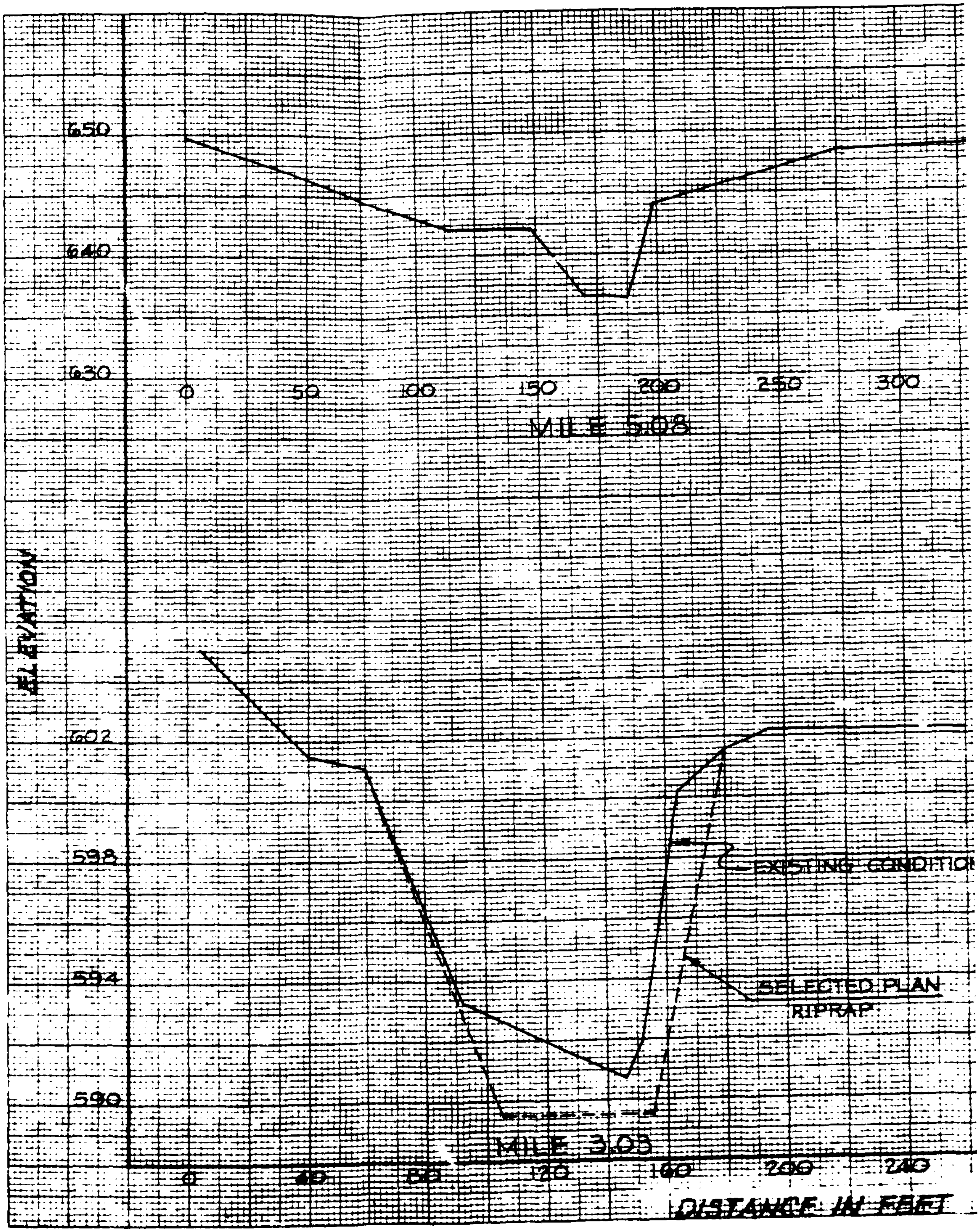
FAIRFIELD OHIO
LOCAL FLOOD PROTECTION PROJECT
TYPICAL
CROSS SECTIONS
PLEASANT RUN

ORLED-H MAY 1981

PLATE D-44

2

47 1323



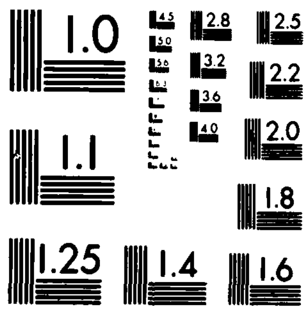
650
640
630
0
50
100
150
200
250
300
MILE 5.08
ELEVATION
602
598
594
590
EXISTING CONDITION
SELECTED PLAN
RIPRAP
MILE 3.03
0
40
80
120
160
200
240
DISTANCE IN FEET

AD-A111 738 ARMY ENGINEER DISTRICT LOUISVILLE KY F/G 13/2
WATER RESOURCES DEVELOPMENT MIAMI RIVER, LITTLE MIAMI RIVER, AN--ETC(U)
OCT 81

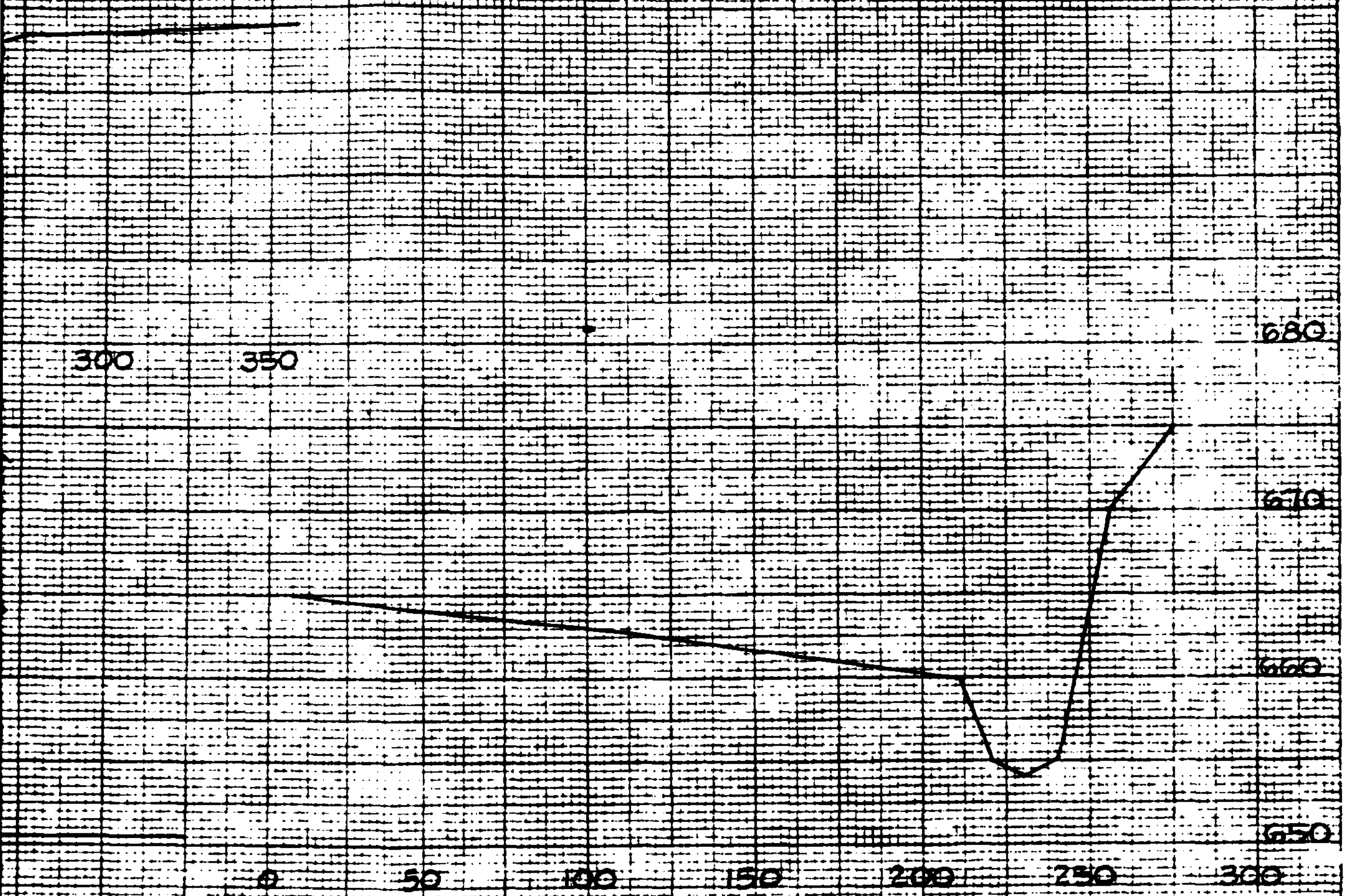
UNCLASSIFIED NL

4 of 6
AD
A111738

11738



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A



MILE 5.50

G CONDITIONS.

ED PLAN
AP

240 280

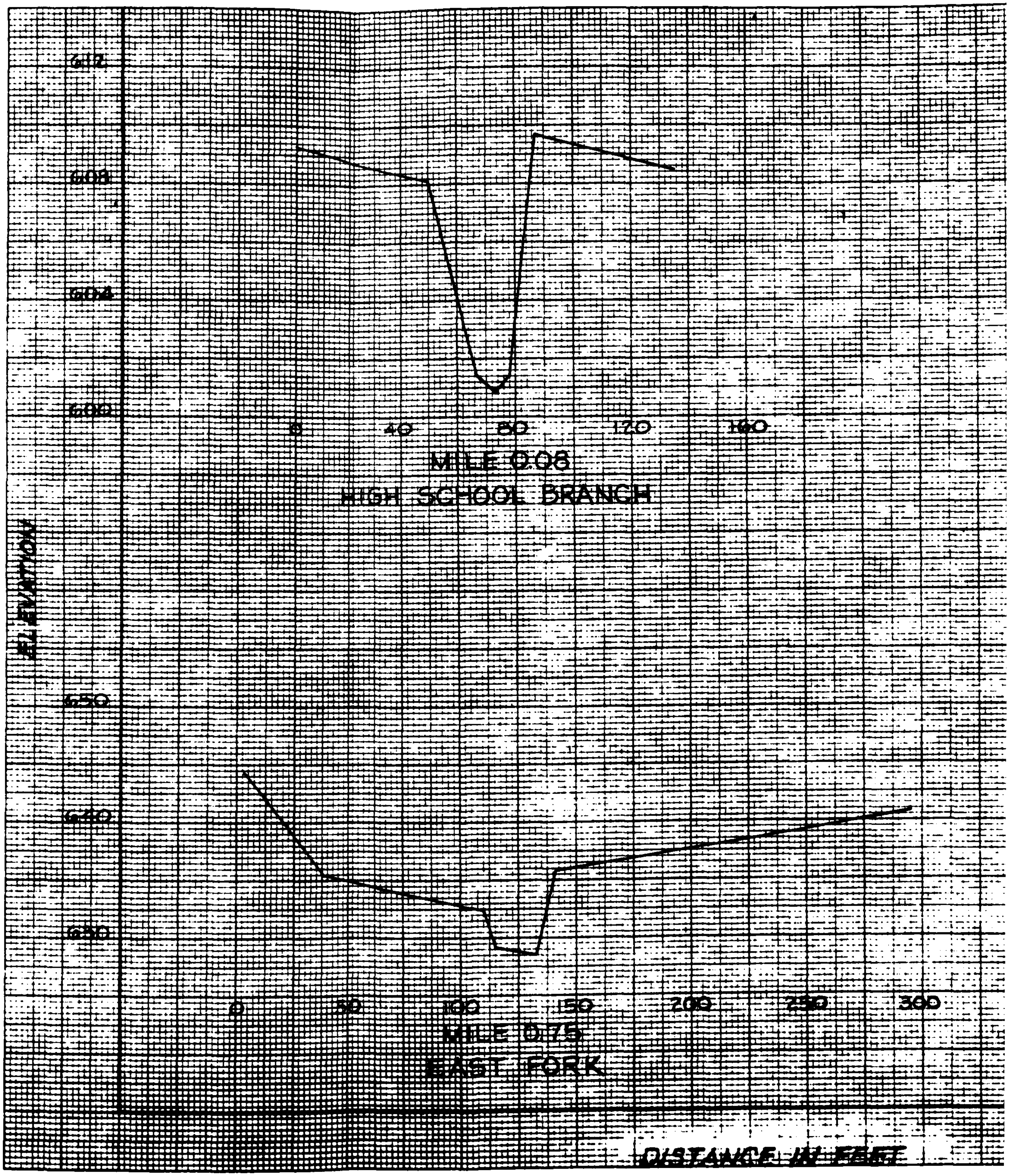
N FEET

FAIRFIELD OHIO
LOCAL FLOOD PROTECTION PROJECT
TYPICAL
CROSS SECTIONS
PLEASANT RUN

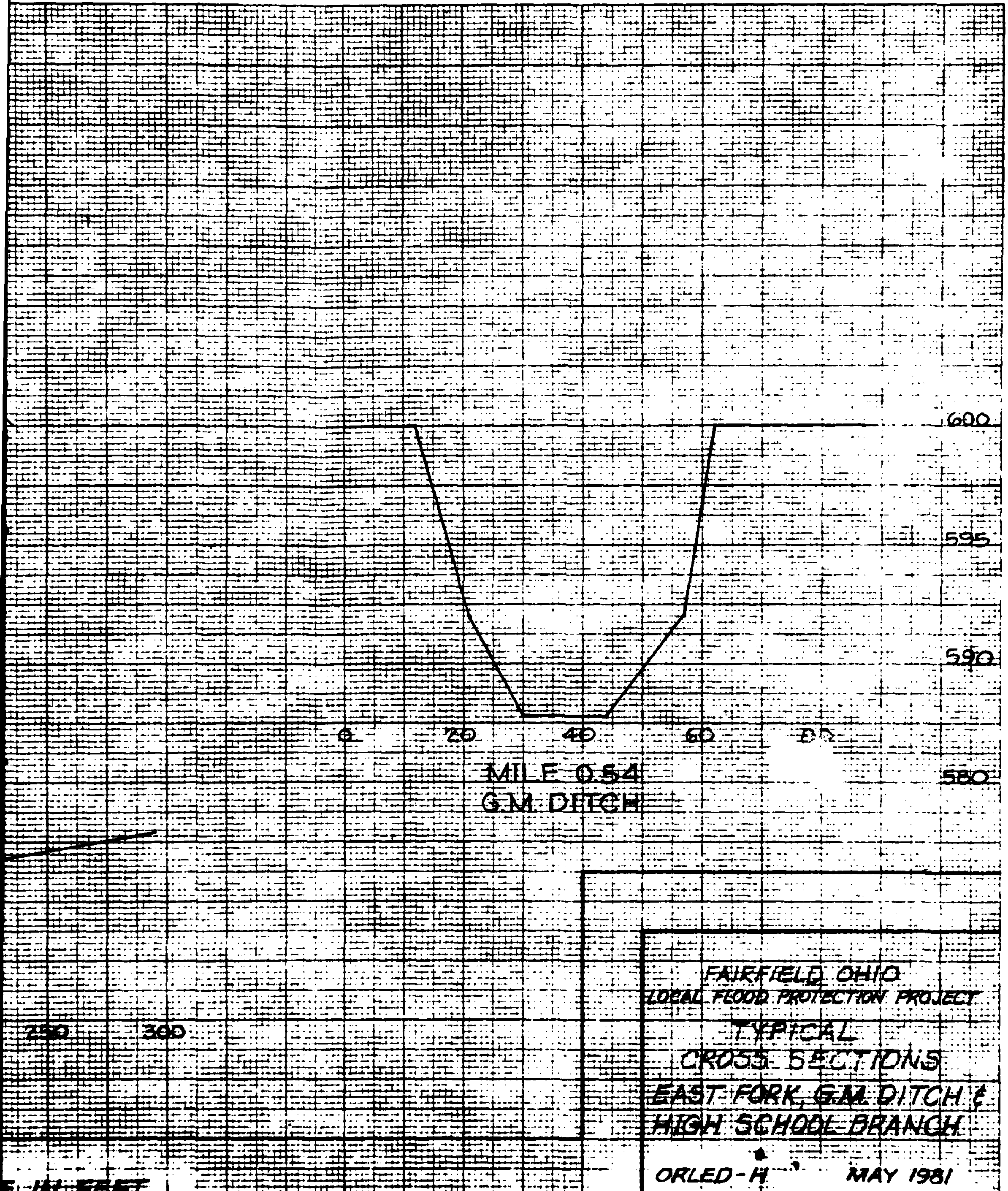
ORLED-H MAY 1981

PLATE D-45

2



612
608
604
600
0
40
80
120
160
MILE 0.08
HIGH SCHOOL BRANCH
ELEVATION
650
640
630
0
50
100
150
200
250
300
MILE 0.75
EAST FORK
DISTANCE IN FEET



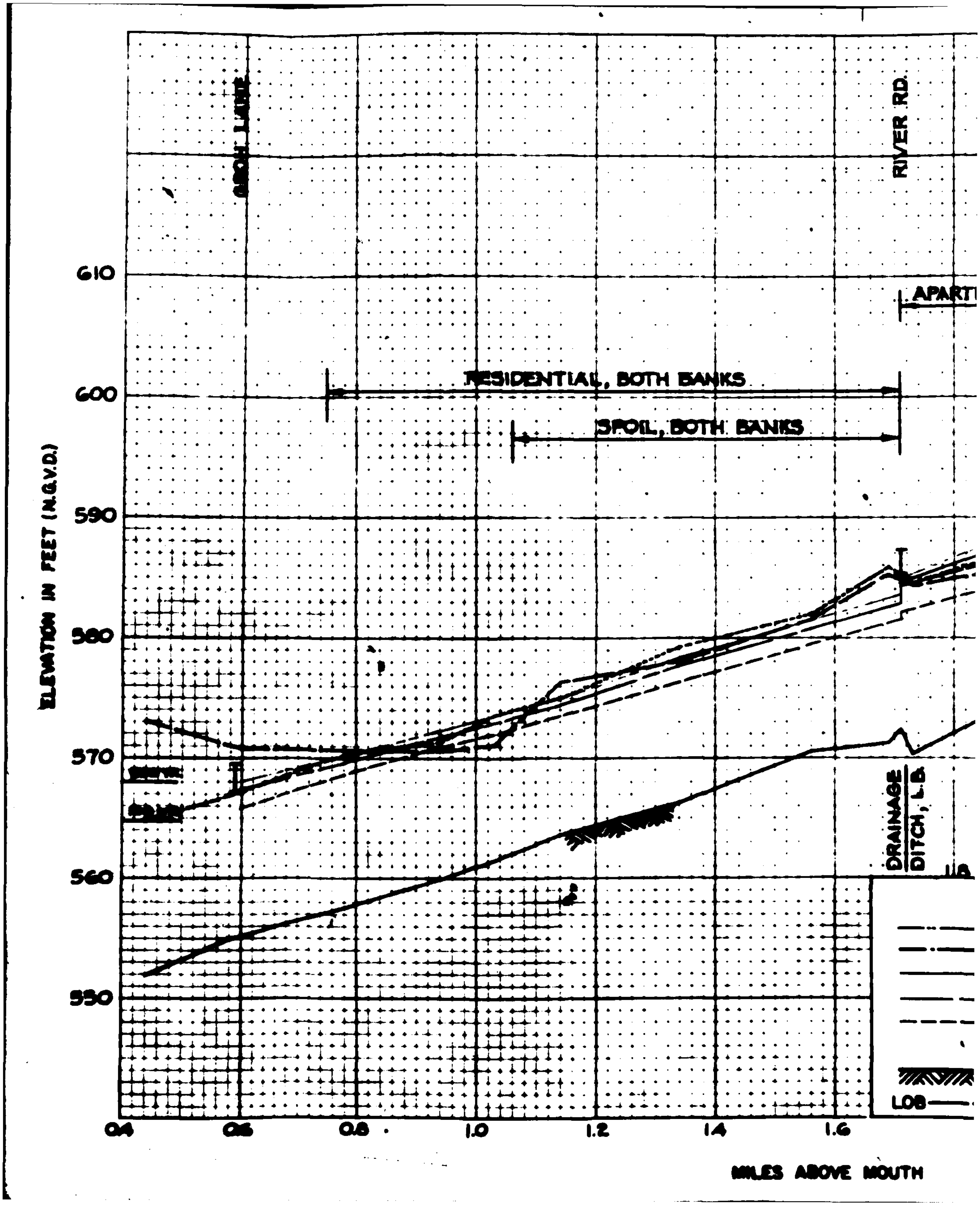
FAIRFIELD OHIO
LOCAL FLOOD PROTECTION PROJECT

TYPICAL
CROSS SECTIONS
EAST FORK, G.M. DITCH &
HIGH SCHOOL BRANCH

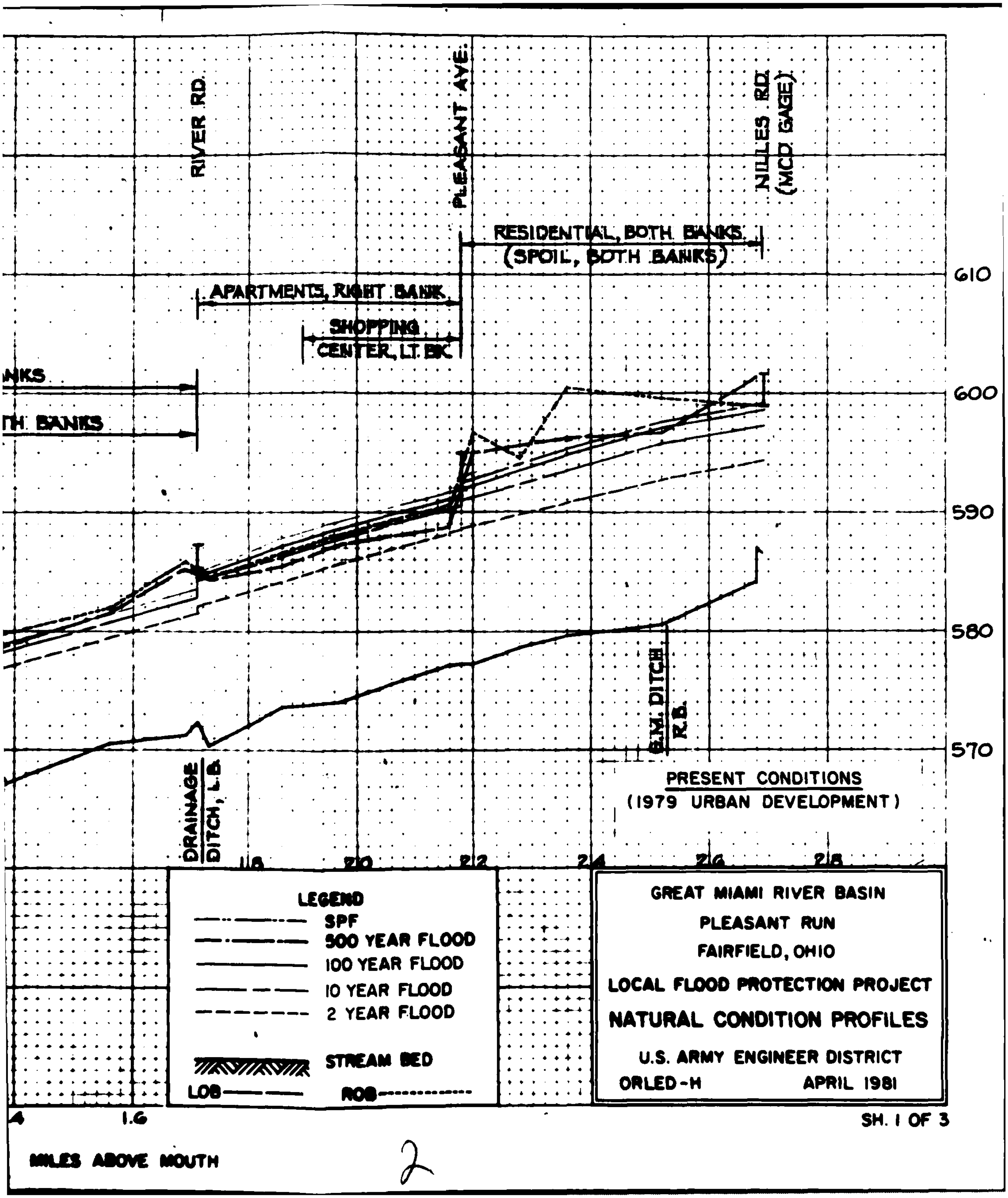
ORLED-H MAY 1981

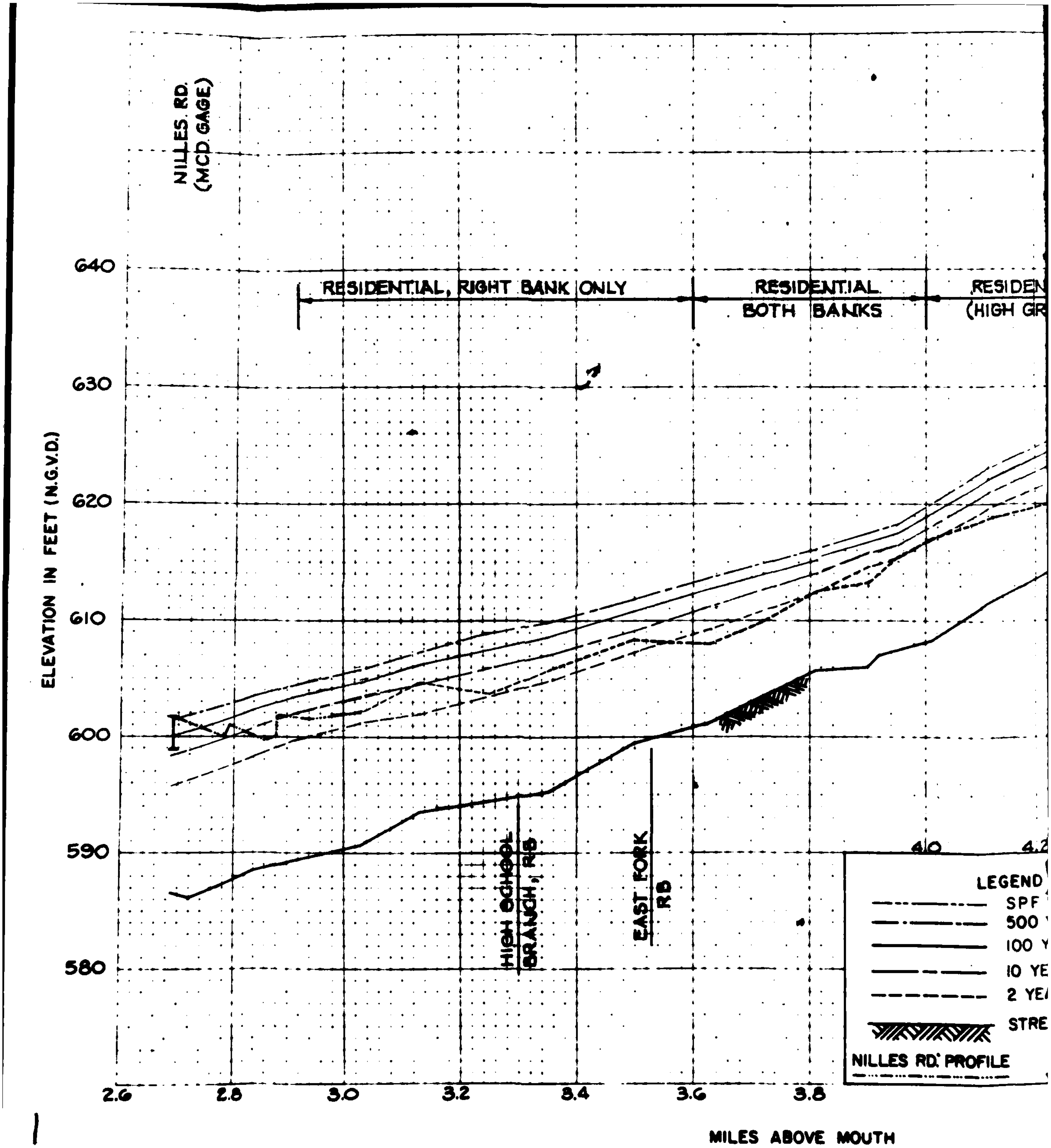
PLATE D-46

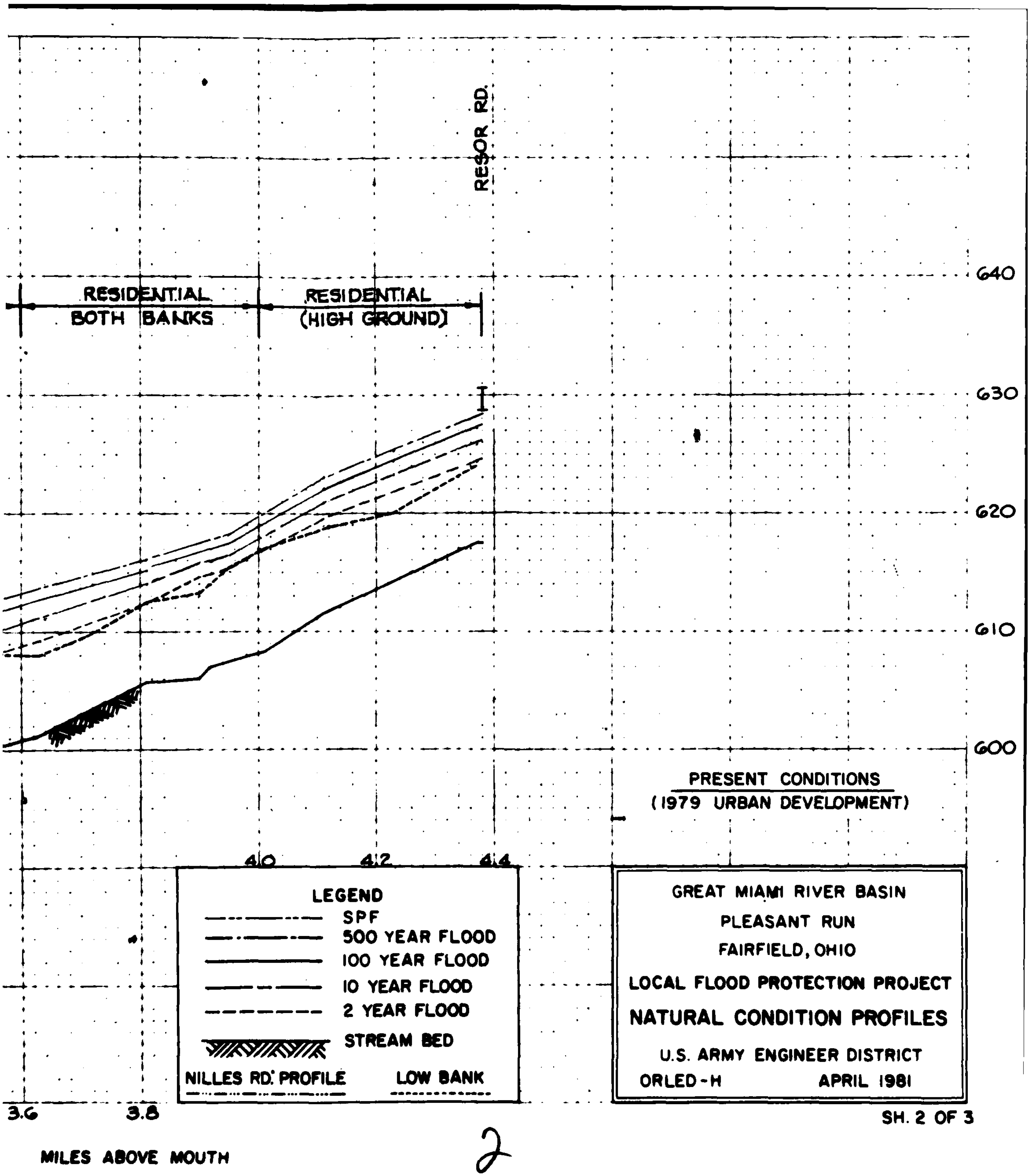
2



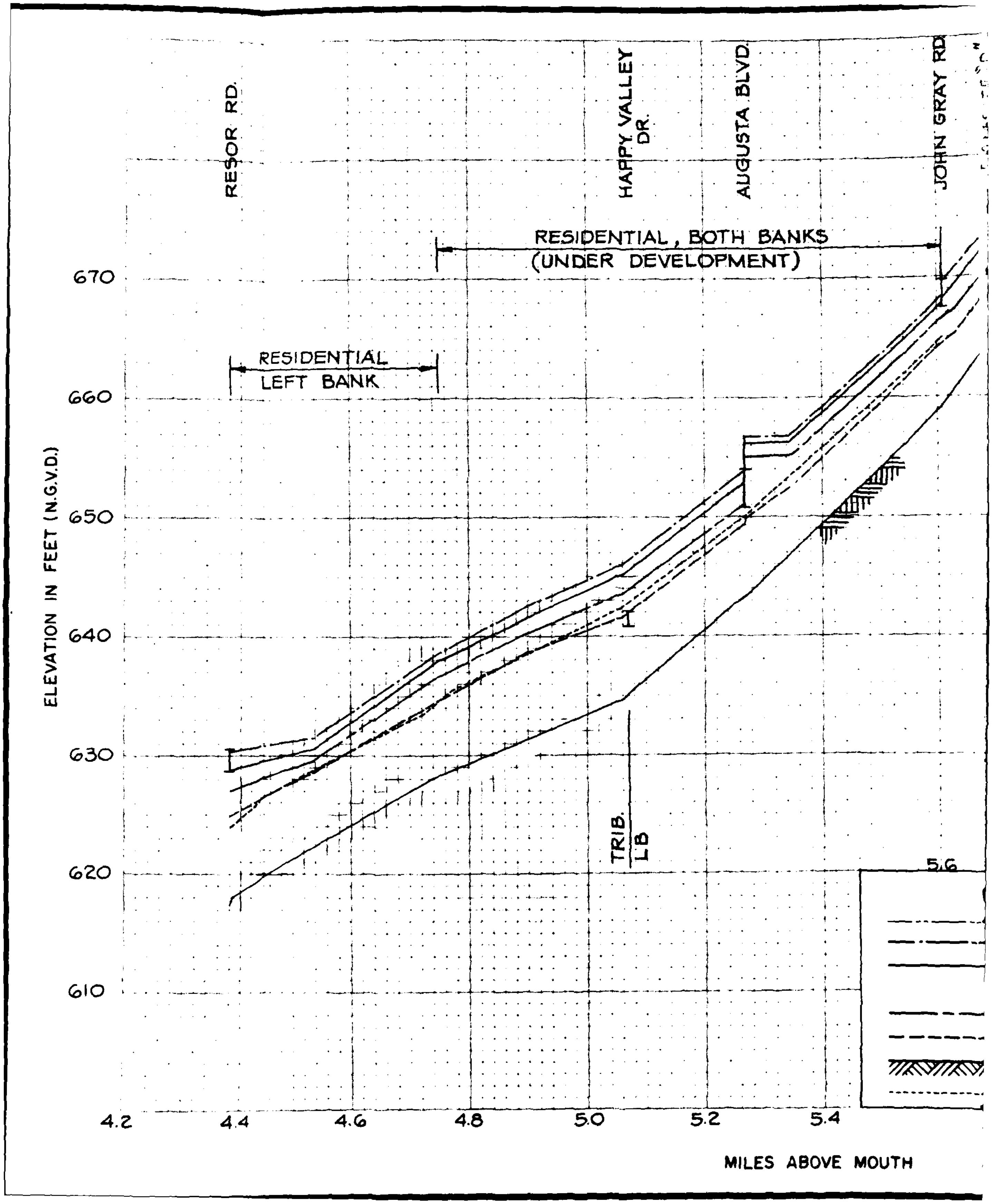
ELEVATION IN FEET (N.G.V.D.)
610
600
590
580
570
560
550
RIVER RD.
RESIDENTIAL, BOTH BANKS
SPOIL, BOTH BANKS
DRAINAGE DITCH, L.B.
LOB
0.4
0.6
0.8
1.0
1.2
1.4
1.6
MILES ABOVE MOUTH

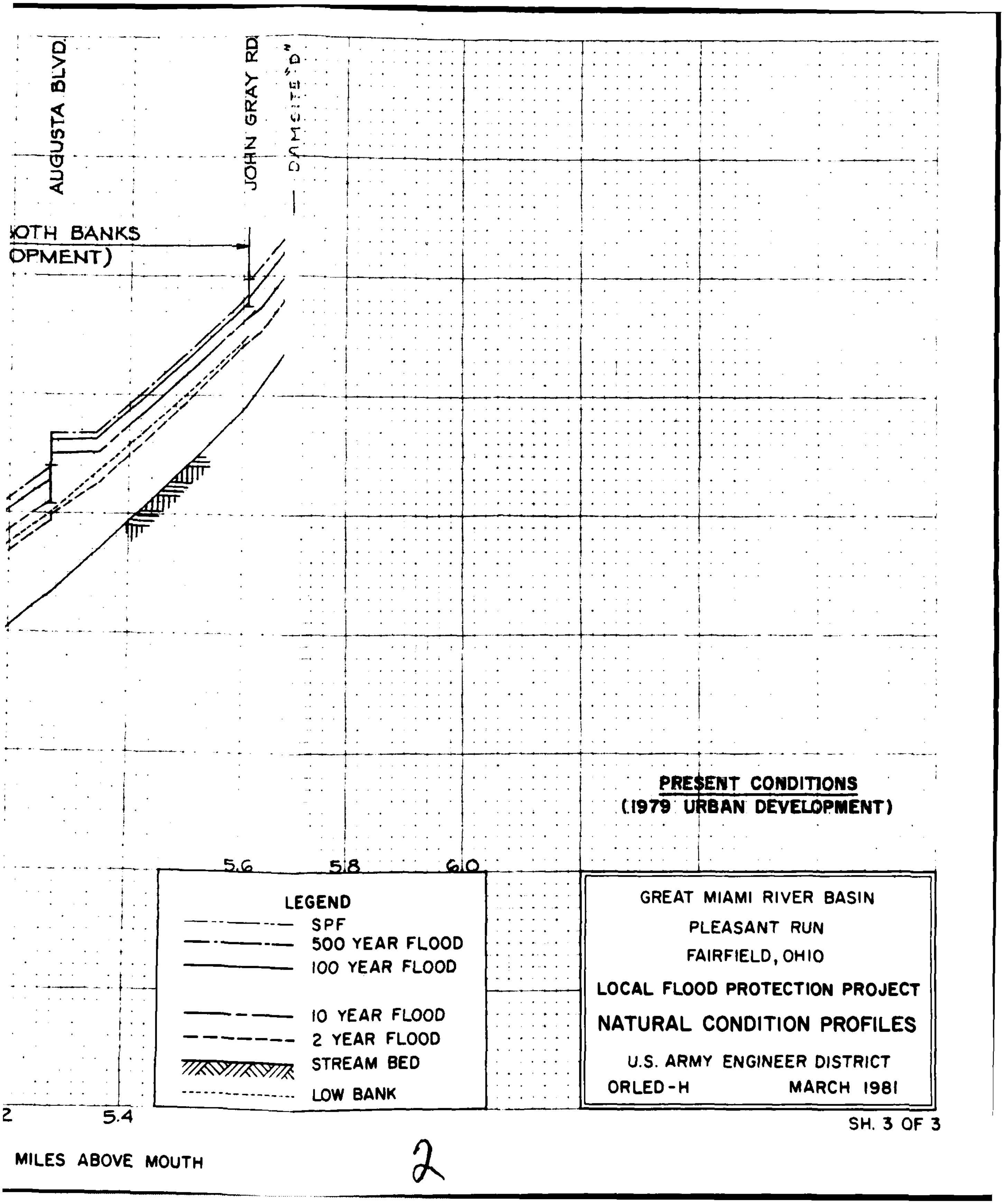

RIVER RD.
PLEASANT AVE.
NILLES RD.
(MCD GAGE)
RESIDENTIAL, BOTH BANKS
(SPOIL, BOTH BANKS)
APARTMENTS, RIGHT BANK
SHOPPING CENTER, LT. BK.
NKS
TH BANKS
610
600
590
580
570
E.M. DITCH R.B.
DRAINAGE DITCH, L.B.
PRESENT CONDITIONS
(1979 URBAN DEVELOPMENT)
1.8
2.0
2.2
2.4
2.6
2.8
LEGEND
SPF
500 YEAR FLOOD
100 YEAR FLOOD
10 YEAR FLOOD
2 YEAR FLOOD
STREAM BED
LOB
ROB
GREAT MIAMI RIVER BASIN
PLEASANT RUN
FAIRFIELD, OHIO
LOCAL FLOOD PROTECTION PROJECT
NATURAL CONDITION PROFILES
U.S. ARMY ENGINEER DISTRICT
ORLED-H
APRIL 1981
1.4
1.6
SH. 1 OF 3
MILES ABOVE MOUTH

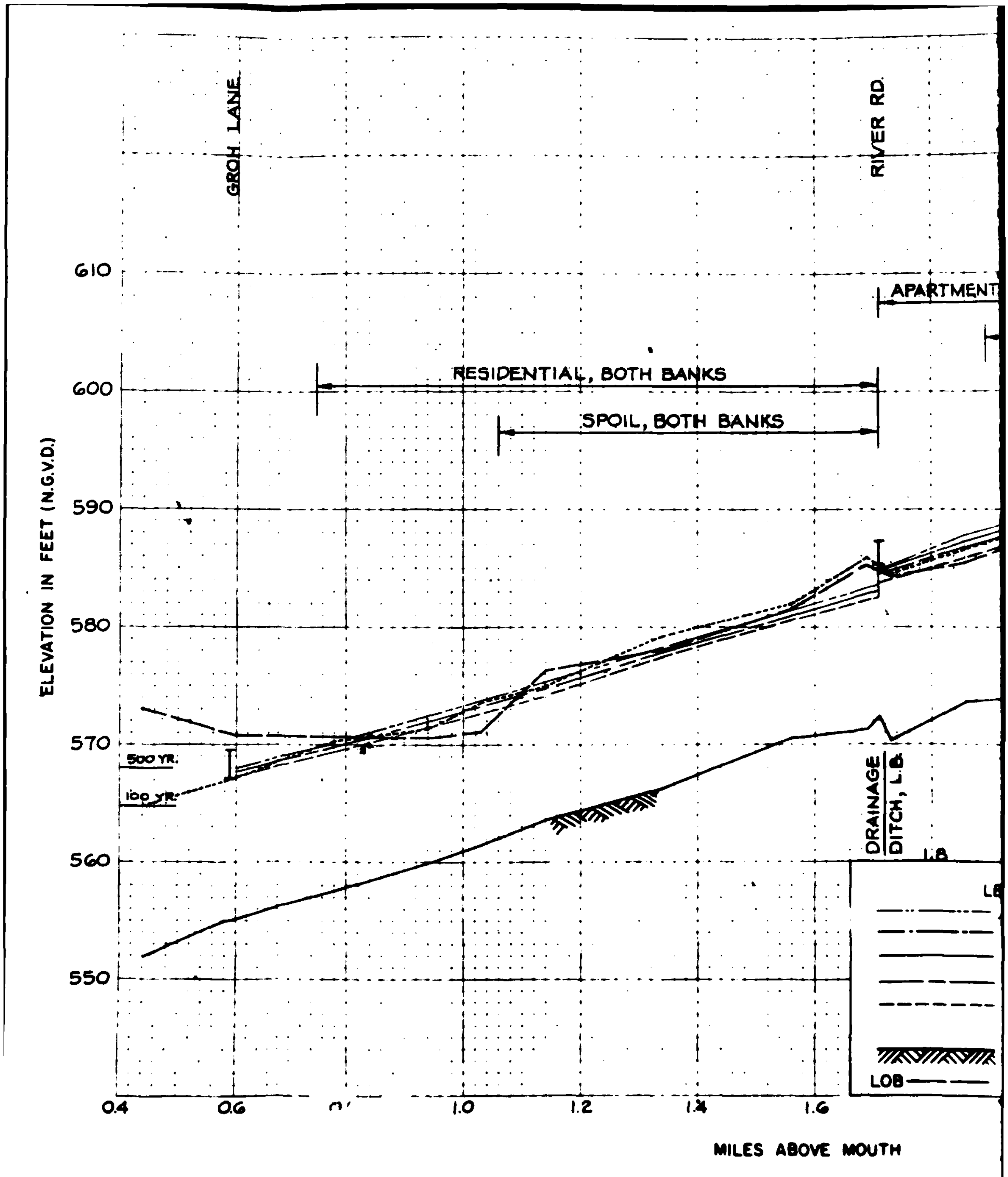

NILLES RD. (MCD GAGE)
RESIDENTIAL, RIGHT BANK ONLY
RESIDENTIAL BOTH BANKS
RESIDEN
(HIGH GR
ELEVATION IN FEET (N.G.V.D.)
640
630
620
610
600
590
580
HIGH SCHOOL BRANCH, RB
EAST FORK RB
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
4.2
MILES ABOVE MOUTH
LEGEND
SPF
500
100 Y
10 YE
2 YE
STRE
NILLES RD. PROFILE

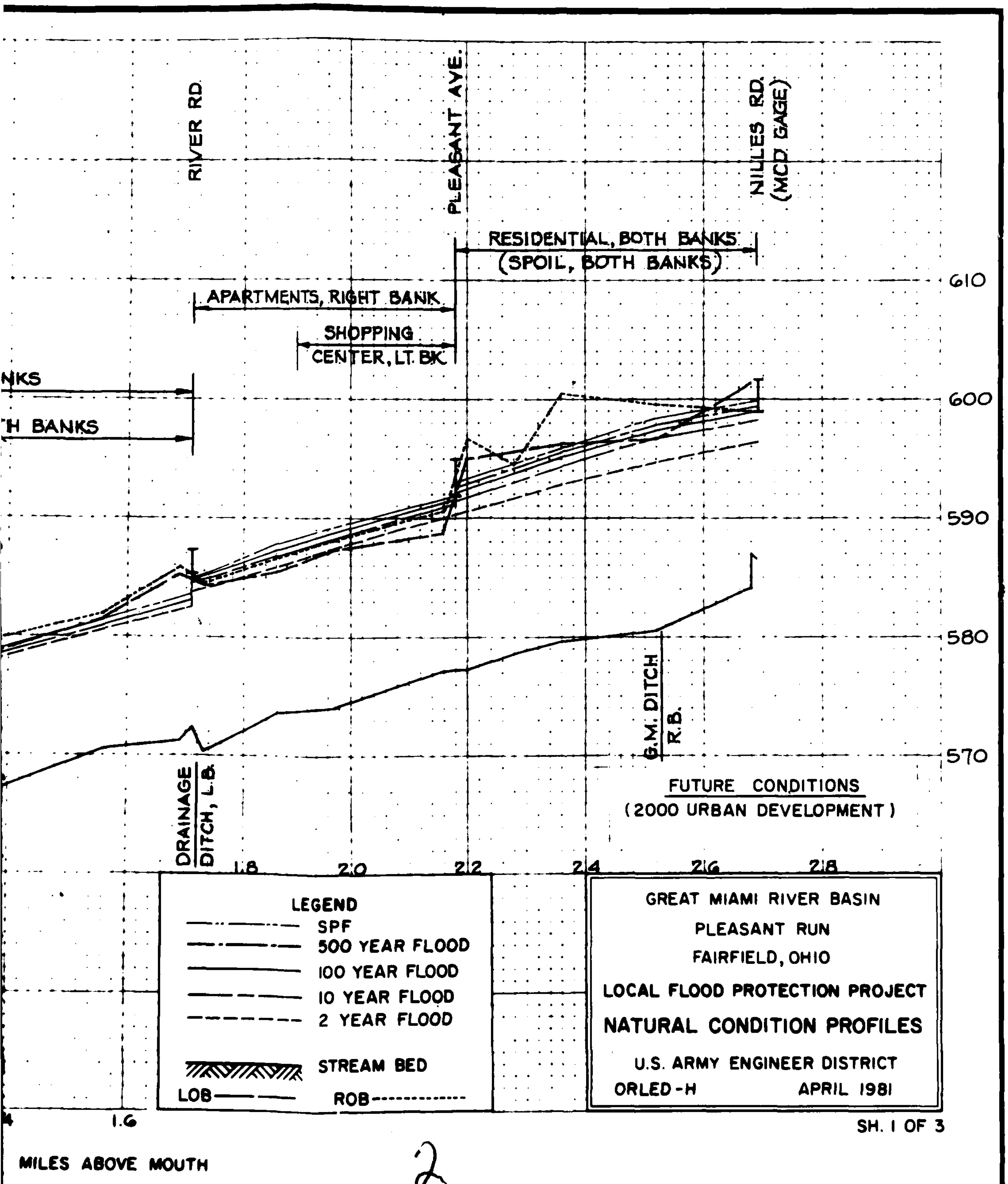

RESOR RD.
RESIDENTIAL BOTH BANKS
RESIDENTIAL (HIGH GROUND)
640
630
620
610
600
PRESENT CONDITIONS
(1979 URBAN DEVELOPMENT)
3.6
3.8
4.0
4.2
4.4
MILES ABOVE MOUTH
LEGEND
SPF
500 YEAR FLOOD
100 YEAR FLOOD
10 YEAR FLOOD
2 YEAR FLOOD
STREAM BED
NILLES RD. PROFILE
LOW BANK
GREAT MIAMI RIVER BASIN
PLEASANT RUN
FAIRFIELD, OHIO
LOCAL FLOOD PROTECTION PROJECT
NATURAL CONDITION PROFILES
U.S. ARMY ENGINEER DISTRICT
ORLED-H
APRIL 1981

SH. 2 OF 3


RESOR RD.
HAPPY VALLEY DR.
AUGUSTA BLVD.
JOHN GRAY RD.
RESIDENTIAL, BOTH BANKS (UNDER DEVELOPMENT)
RESIDENTIAL LEFT BANK
TRIB. LB
ELEVATION IN FEET (N.G.V.D.)
670
660
650
640
630
620
610
4.2
4.4
4.6
4.8
5.0
5.2
5.4
5.6
MILES ABOVE MOUTH


AUGUSTA BLVD.
JOHN GRAY RD.
DAMSITE "D"
BOTH BANKS
OPMENT)
PRESENT CONDITIONS
(1979 URBAN DEVELOPMENT)
5.6
5.8
6.0
LEGEND
SPF
500 YEAR FLOOD
100 YEAR FLOOD
10 YEAR FLOOD
2 YEAR FLOOD
STREAM BED
LOW BANK
GREAT MIAMI RIVER BASIN
PLEASANT RUN
FAIRFIELD, OHIO
LOCAL FLOOD PROTECTION PROJECT
NATURAL CONDITION PROFILES
U.S. ARMY ENGINEER DISTRICT
ORLED-H
MARCH 1981
2
5.4
SH. 3 OF 3
MILES ABOVE MOUTH
2

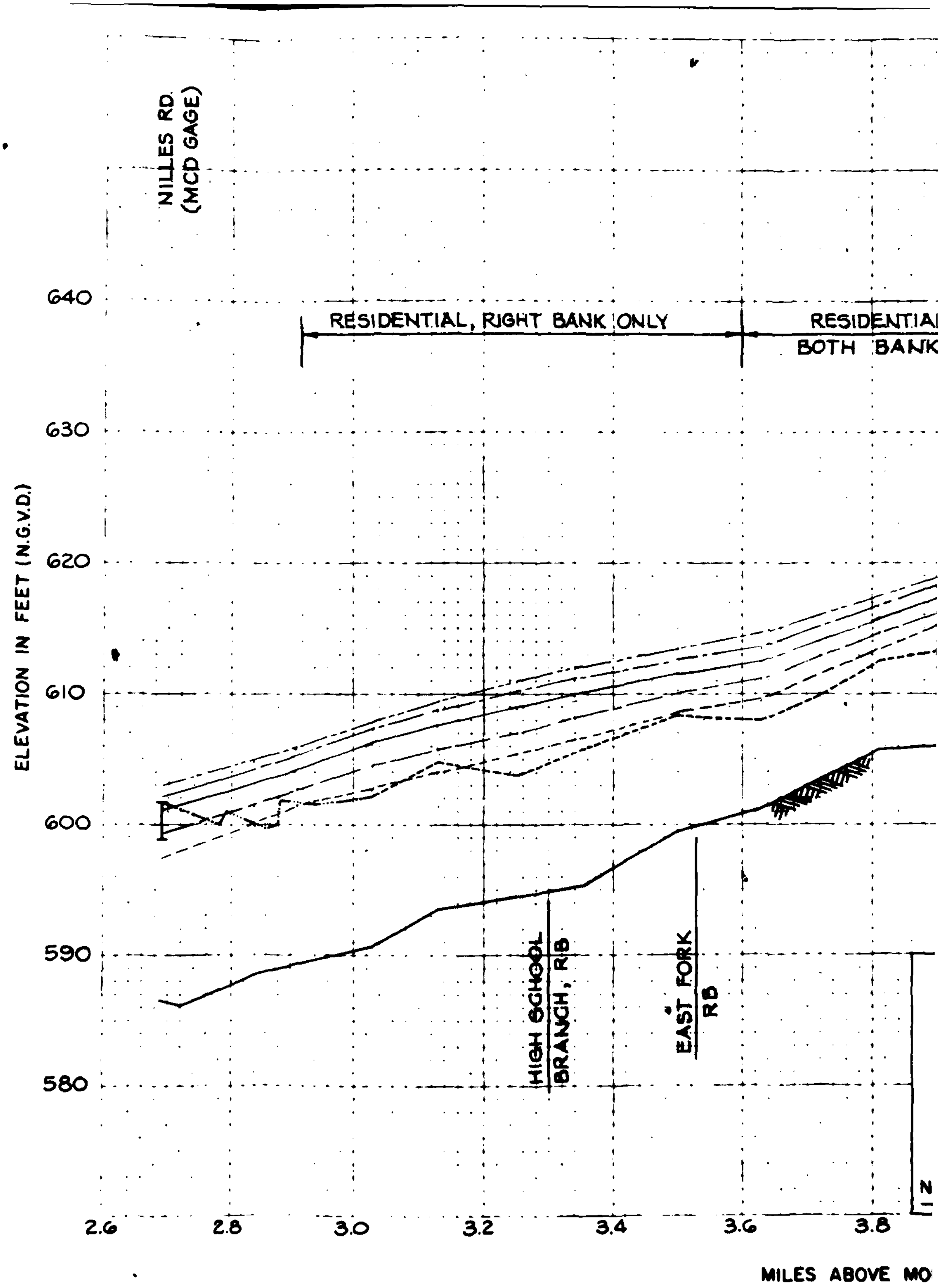

GROH LANE
RIVER RD.
APARTMENT
RESIDENTIAL, BOTH BANKS
SPOIL, BOTH BANKS
ELEVATION IN FEET (N.G.V.D.)
610
600
590
580
570
560
550
500 YR.
100 YR.
DRAINAGE DITCH, L.B.
L.B.
LOB
0.4
0.6
1.0
1.2
1.4
1.6
MILES ABOVE MOUTH



GREAT MIAMI RIVER BASIN
PLEASANT RUN
FAIRFIELD, OHIO
LOCAL FLOOD PROTECTION PROJECT
NATURAL CONDITION PROFILES
U.S. ARMY ENGINEER DISTRICT
ORLED-H APRIL 1981

SH. 1 OF 3

2


NILLES RD. (MCD GAGE)
RESIDENTIAL, RIGHT BANK ONLY
RESIDENTIAL BOTH BANK
ELEVATION IN FEET (N.G.V.D.)
640
630
620
610
600
590
580
HIGH SCHOOL BRANCH, RB
EAST FORK RB
2.6
2.8
3.0
3.2
3.4
3.6
3.8
MILES ABOVE MO

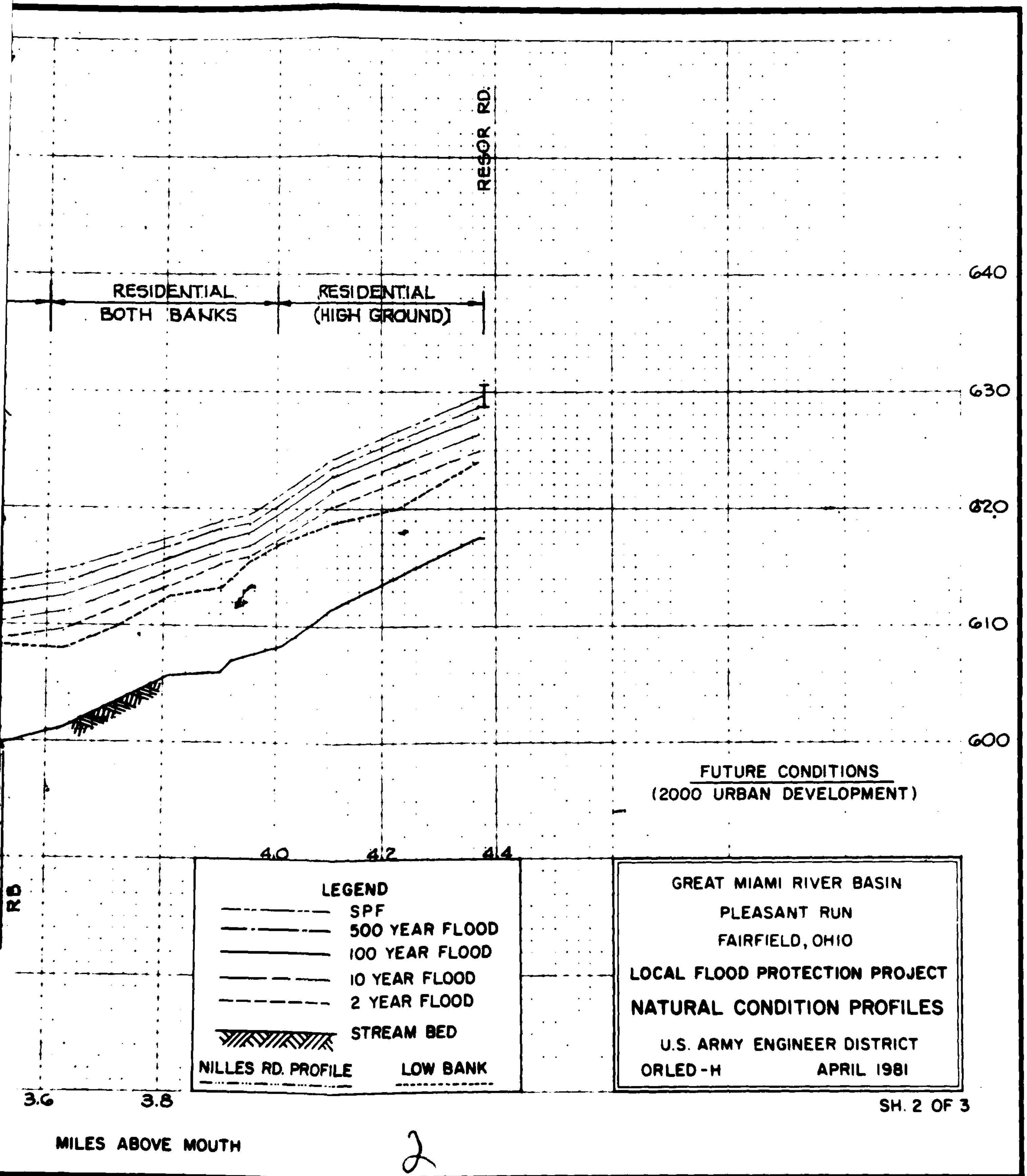
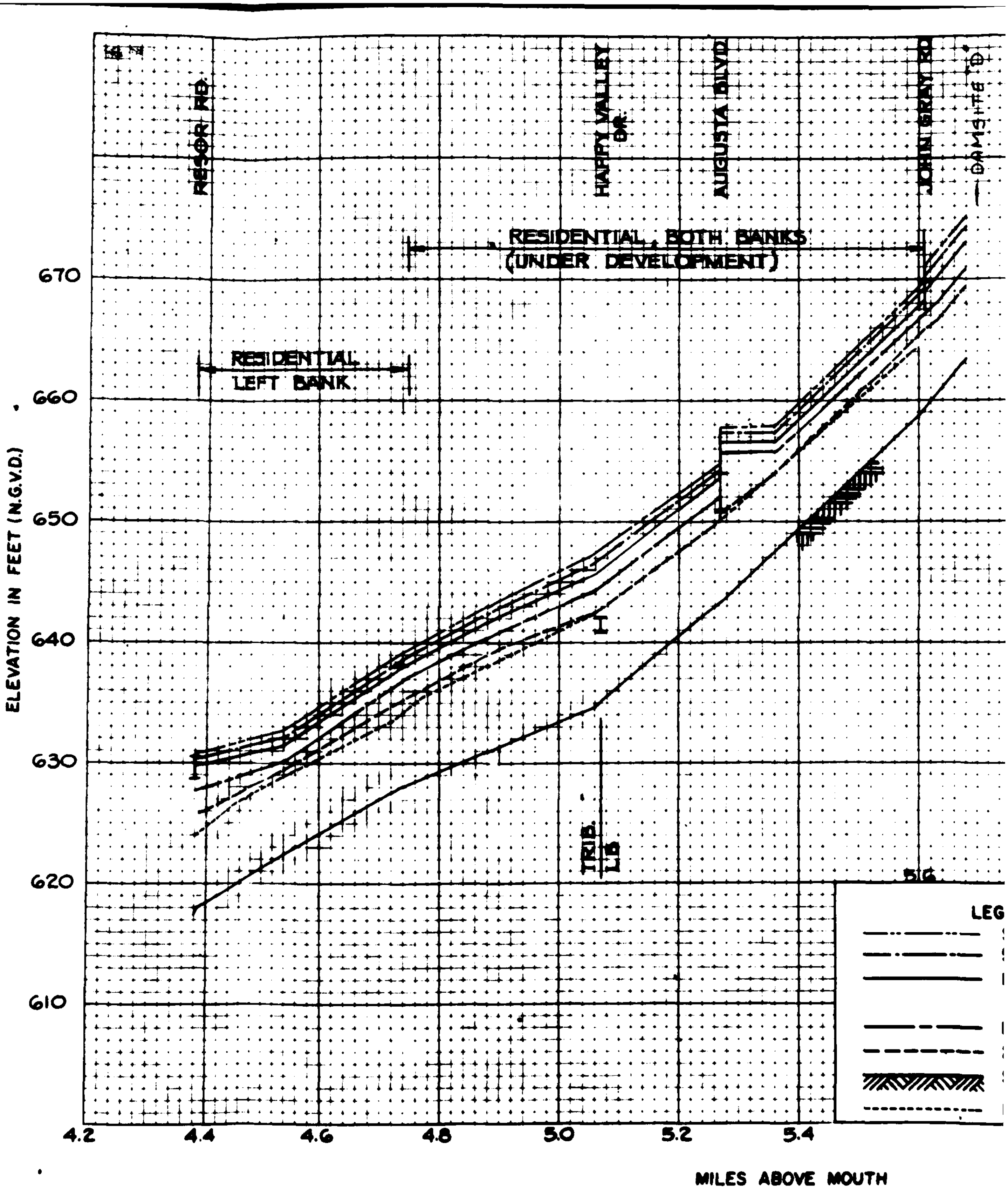
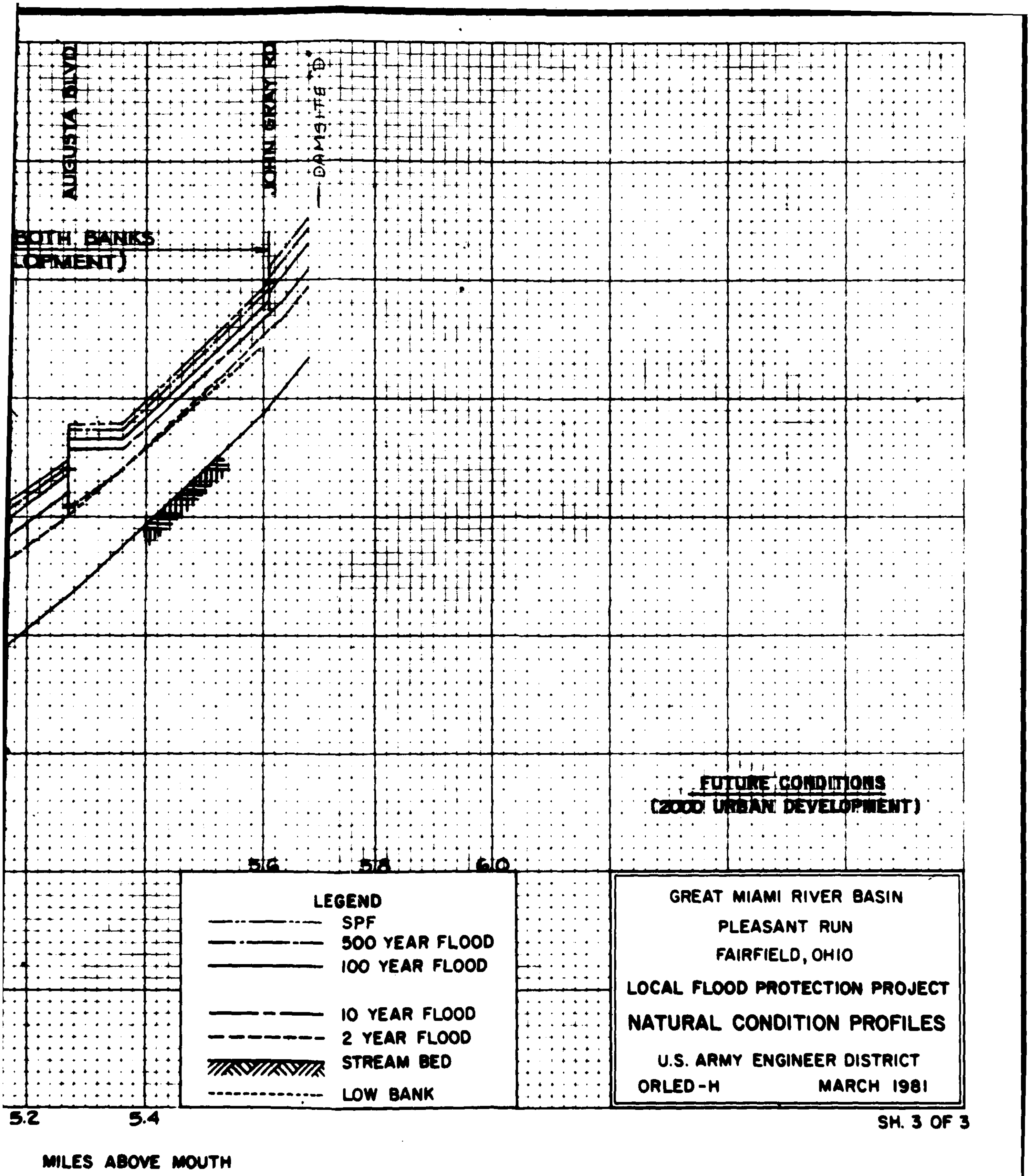

RESOR RD.
RESIDENTIAL BOTH BANKS
RESIDENTIAL (HIGH GROUND)
640
630
620
610
600
FUTURE CONDITIONS
(2000 URBAN DEVELOPMENT)
RB
3.6
3.8
4.0
4.2
4.4
LEGEND
SPF
500 YEAR FLOOD
100 YEAR FLOOD
10 YEAR FLOOD
2 YEAR FLOOD
STREAM BED
NILLES RD. PROFILE
LOW BANK
GREAT MIAMI RIVER BASIN
PLEASANT RUN
FAIRFIELD, OHIO
LOCAL FLOOD PROTECTION PROJECT
NATURAL CONDITION PROFILES
U.S. ARMY ENGINEER DISTRICT
ORLED-H
APRIL 1981
SH. 2 OF 3
MILES ABOVE MOUTH
2

PLATE D-51


RESOR RD.
HAPPY VALLEY DR.
AUGUSTA BLVD.
JOHN GRAY RD.
DAMSITE D
RESIDENTIAL, BOTH BANKS
(UNDER DEVELOPMENT)
RESIDENTIAL
LEFT BANK
TRIB. L.B.
670
660
650
640
630
620
610
ELEVATION IN FEET (N.G.V.D.)
4.2
4.4
4.6
4.8
5.0
5.2
5.4
MILES ABOVE MOUTH
LEG



GREAT MIAMI RIVER BASIN

PLEASANT RUN

FAIRFIELD, OHIO

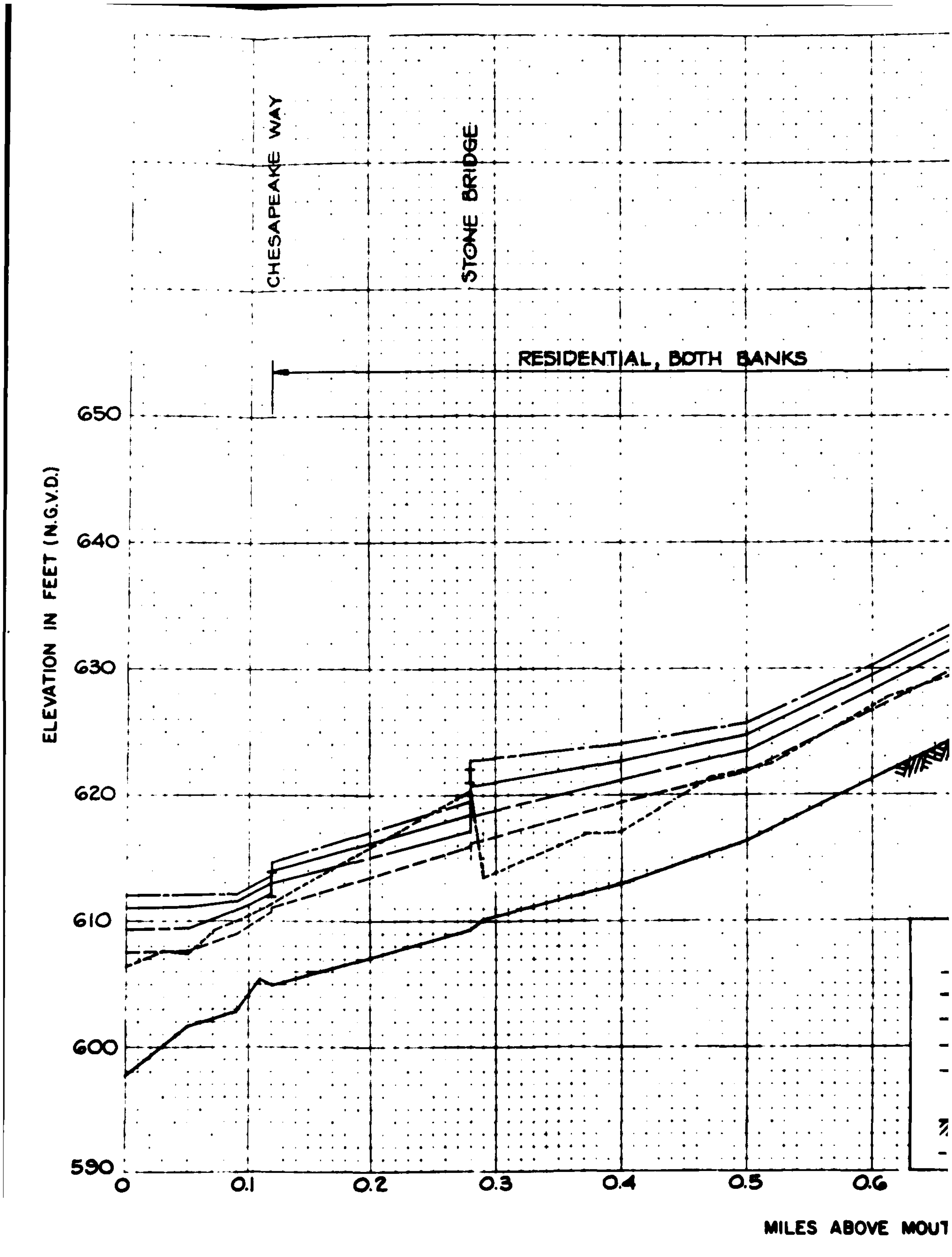
LOCAL FLOOD PROTECTION PROJECT

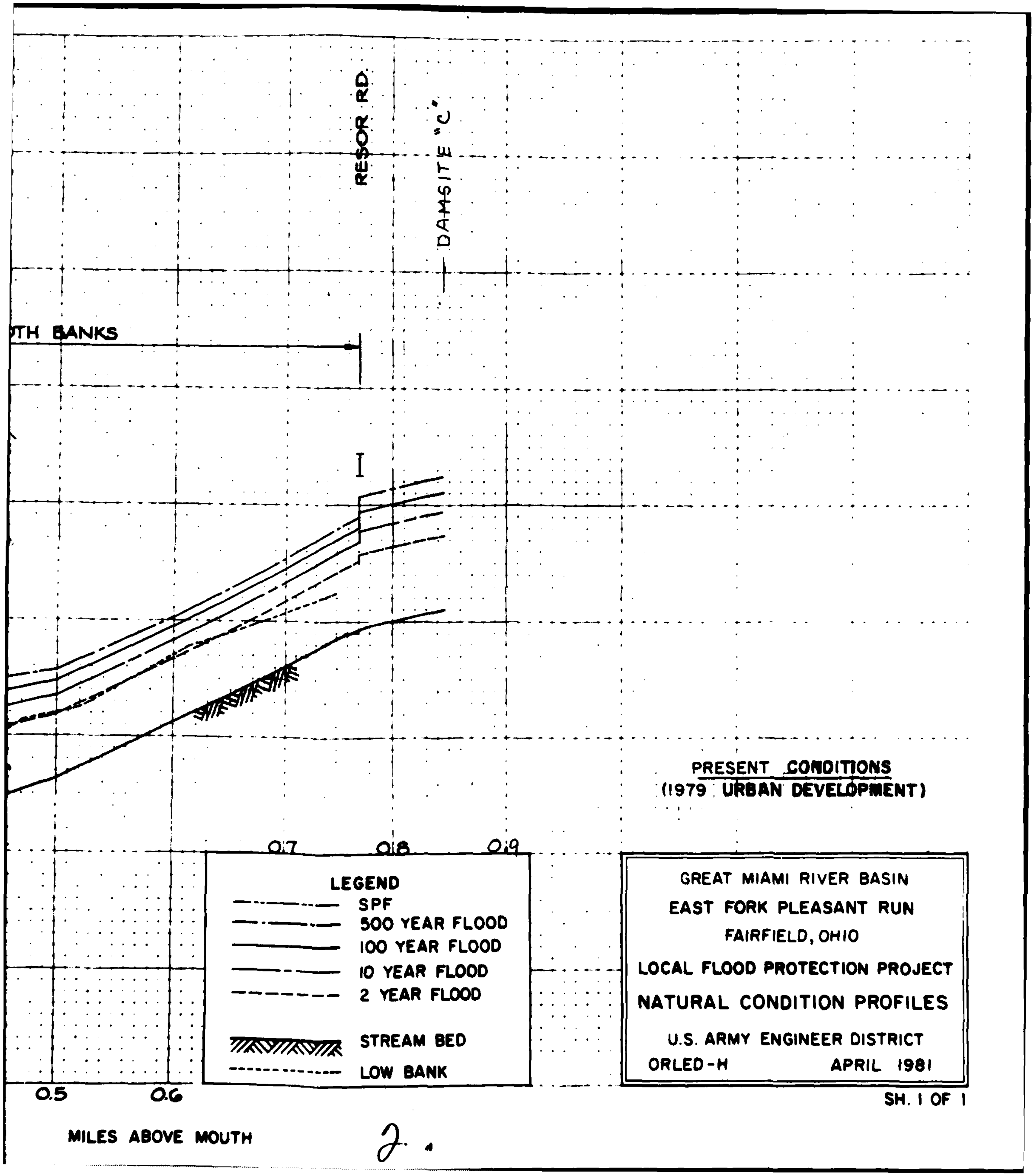
NATURAL CONDITION PROFILES

U.S. ARMY ENGINEER DISTRICT

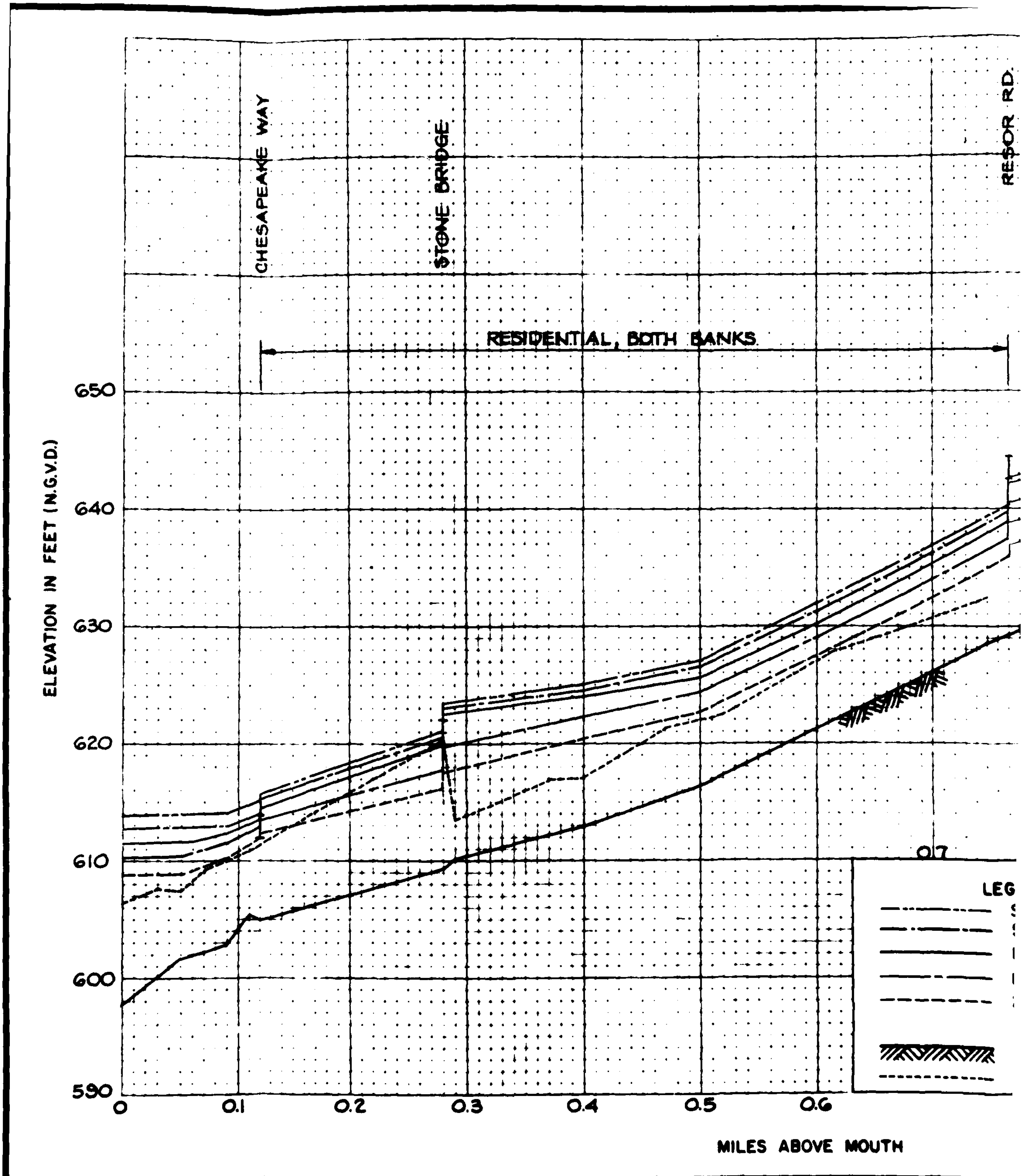
ORLED-H MARCH 1981

SH. 3 OF 3

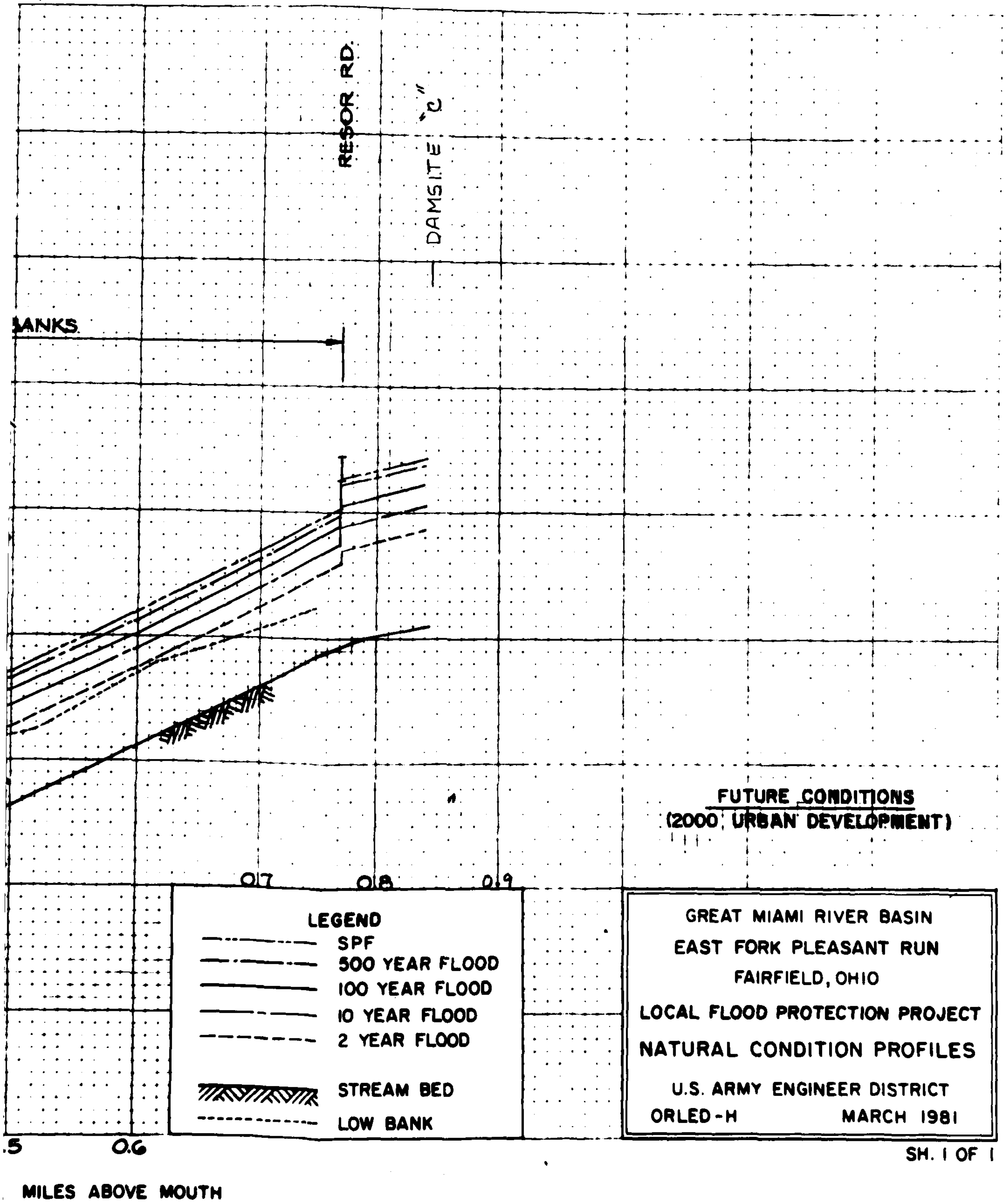

CHESAPEAKE WAY
STONE BRIDGE
RESIDENTIAL, BOTH BANKS
ELEVATION IN FEET (N.G.V.D.)
650
640
630
620
610
600
590
0
0.1
0.2
0.3
0.4
0.5
0.6
MILES ABOVE MOUT



RESOR RD.
DAMSITE "C"
TH BANKS
PRESENT CONDITIONS
(1979 URBAN DEVELOPMENT)
0.5
0.6
0.7
0.8
0.9
MILES ABOVE MOUTH
LEGEND
SPF
500 YEAR FLOOD
100 YEAR FLOOD
10 YEAR FLOOD
2 YEAR FLOOD
STREAM BED
LOW BANK
GREAT MIAMI RIVER BASIN
EAST FORK PLEASANT RUN
FAIRFIELD, OHIO
LOCAL FLOOD PROTECTION PROJECT
NATURAL CONDITION PROFILES
U.S. ARMY ENGINEER DISTRICT
ORLED-H
APRIL 1981
SH. 1 OF 1
2.

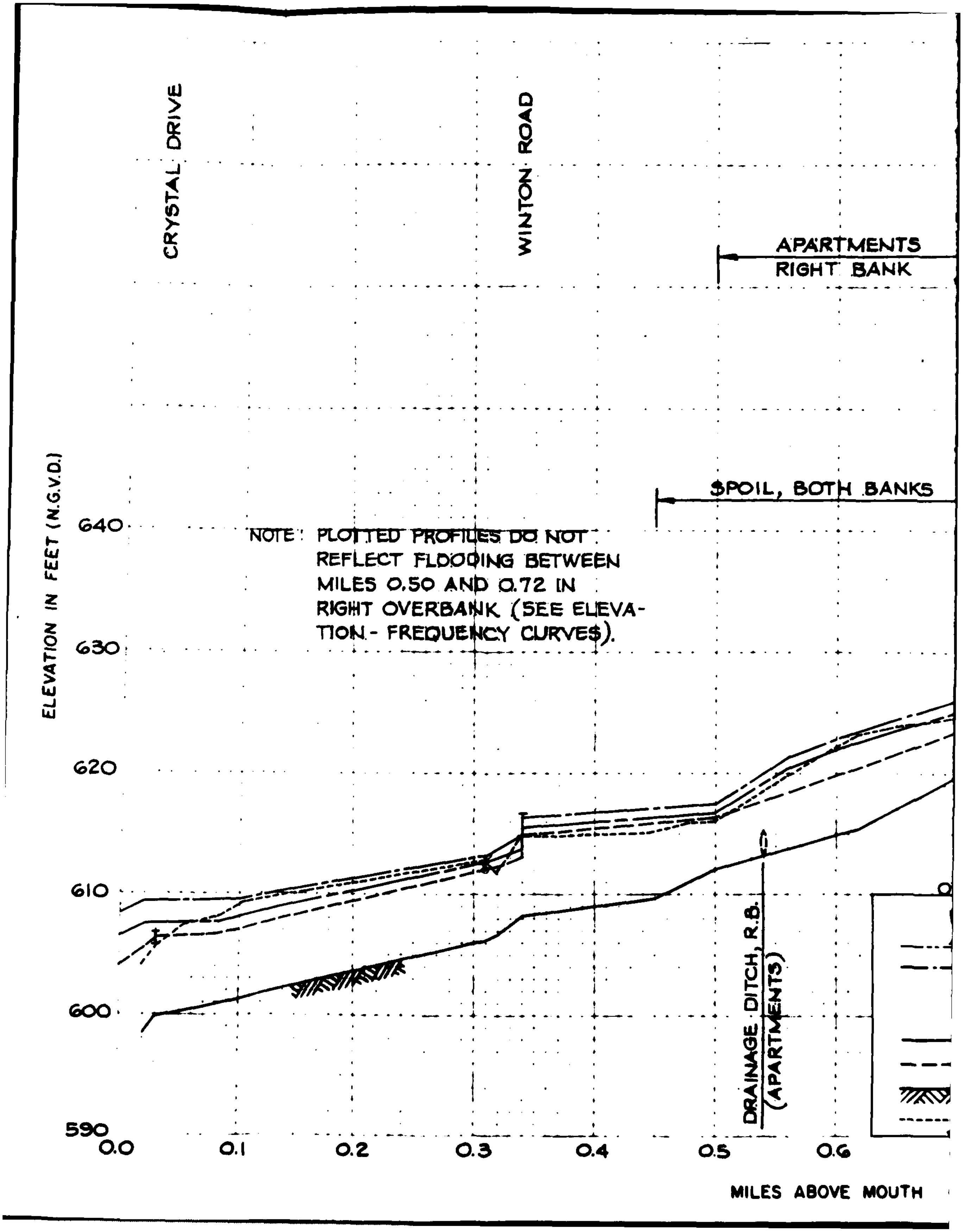


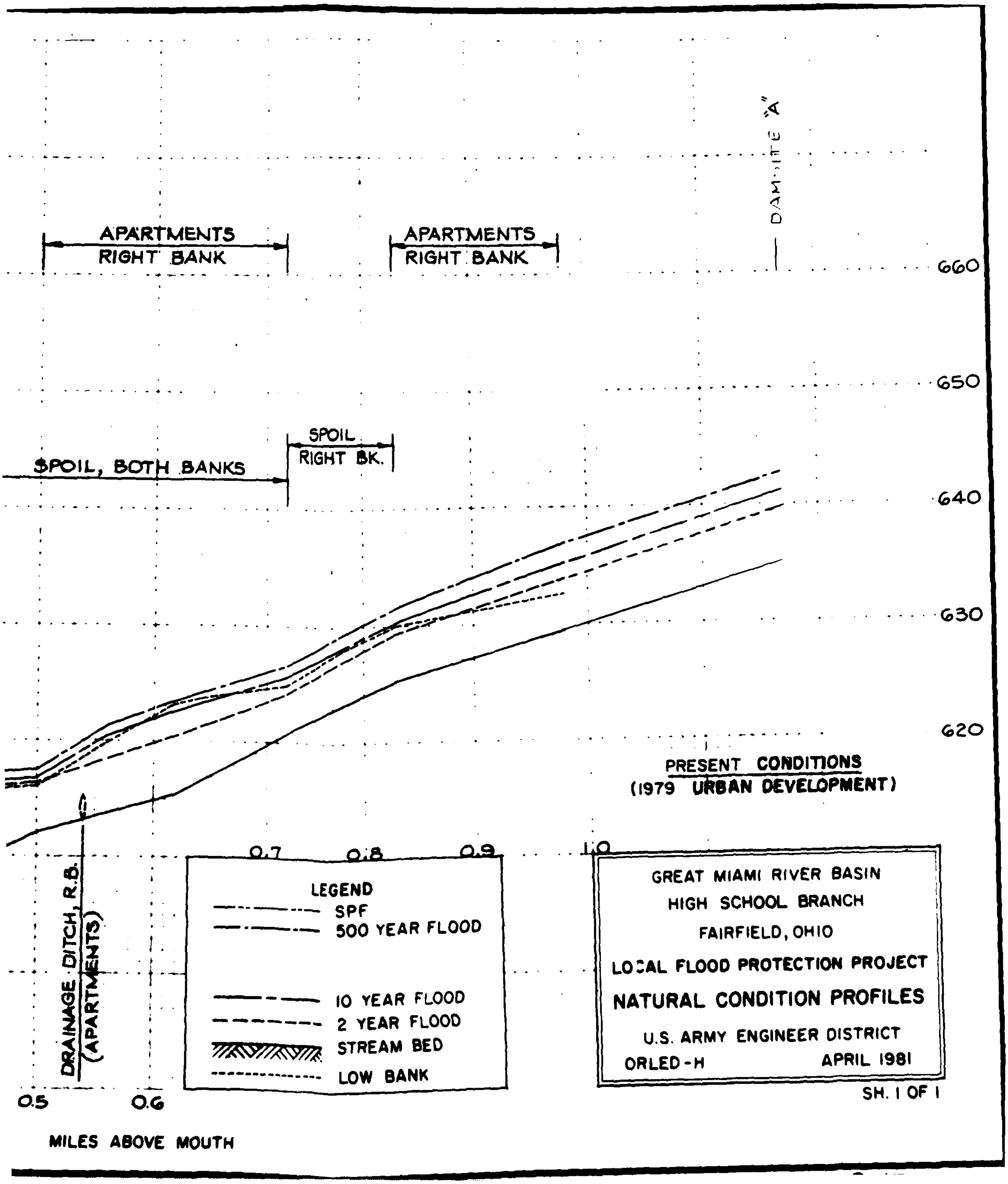
CHESAPEAKE WAY
STONE BRIDGE
RESOR RD.
RESIDENTIAL, BOTH BANKS
650
640
630
620
610
600
590
ELEVATION IN FEET (N.G.V.D.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
MILES ABOVE MOUTH
LEG



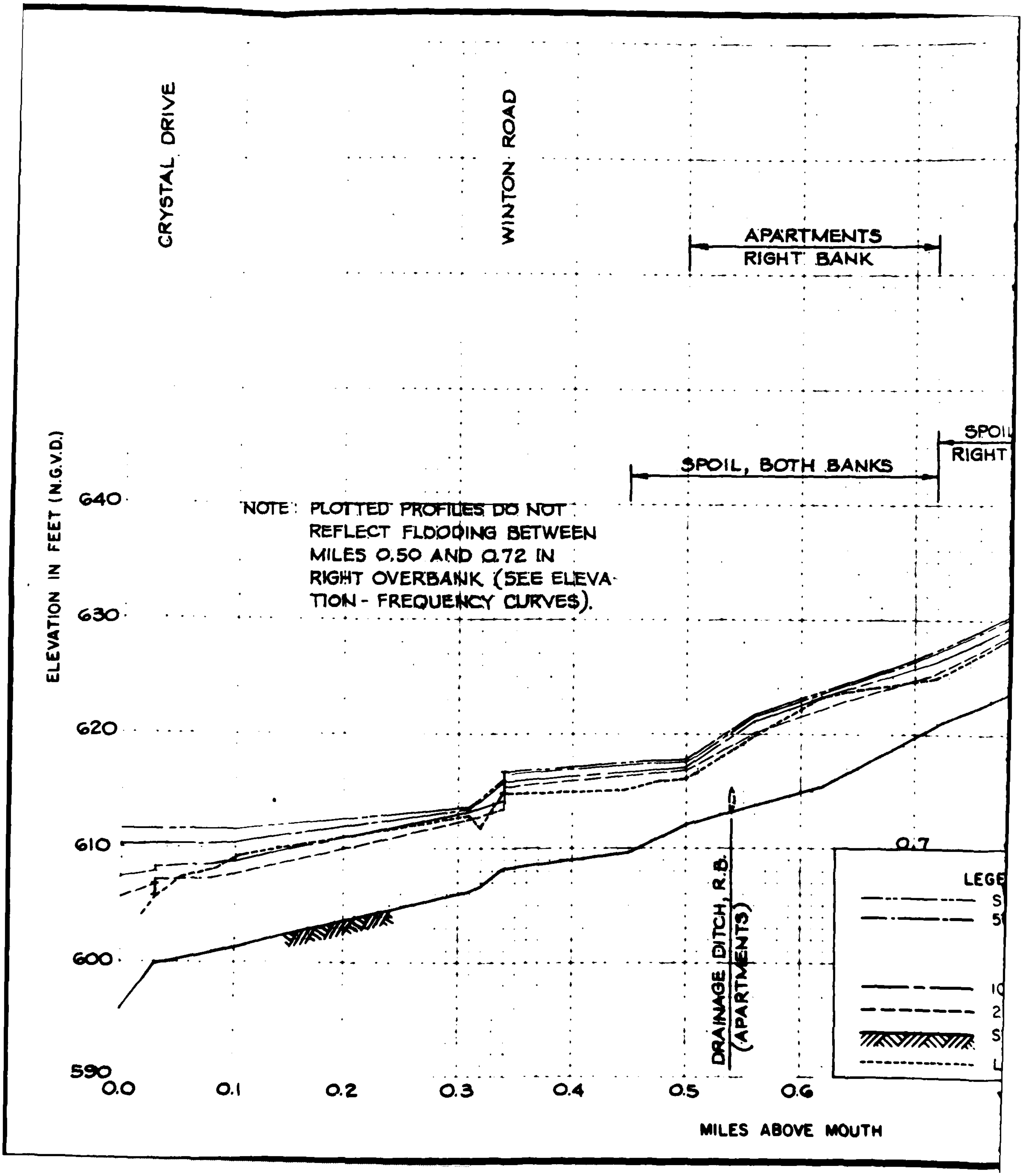
GREAT MIAMI RIVER BASIN
EAST FORK PLEASANT RUN
FAIRFIELD, OHIO
LOCAL FLOOD PROTECTION PROJECT
NATURAL CONDITION PROFILES
U.S. ARMY ENGINEER DISTRICT
ORLED-H MARCH 1981

SH. 1 OF 1

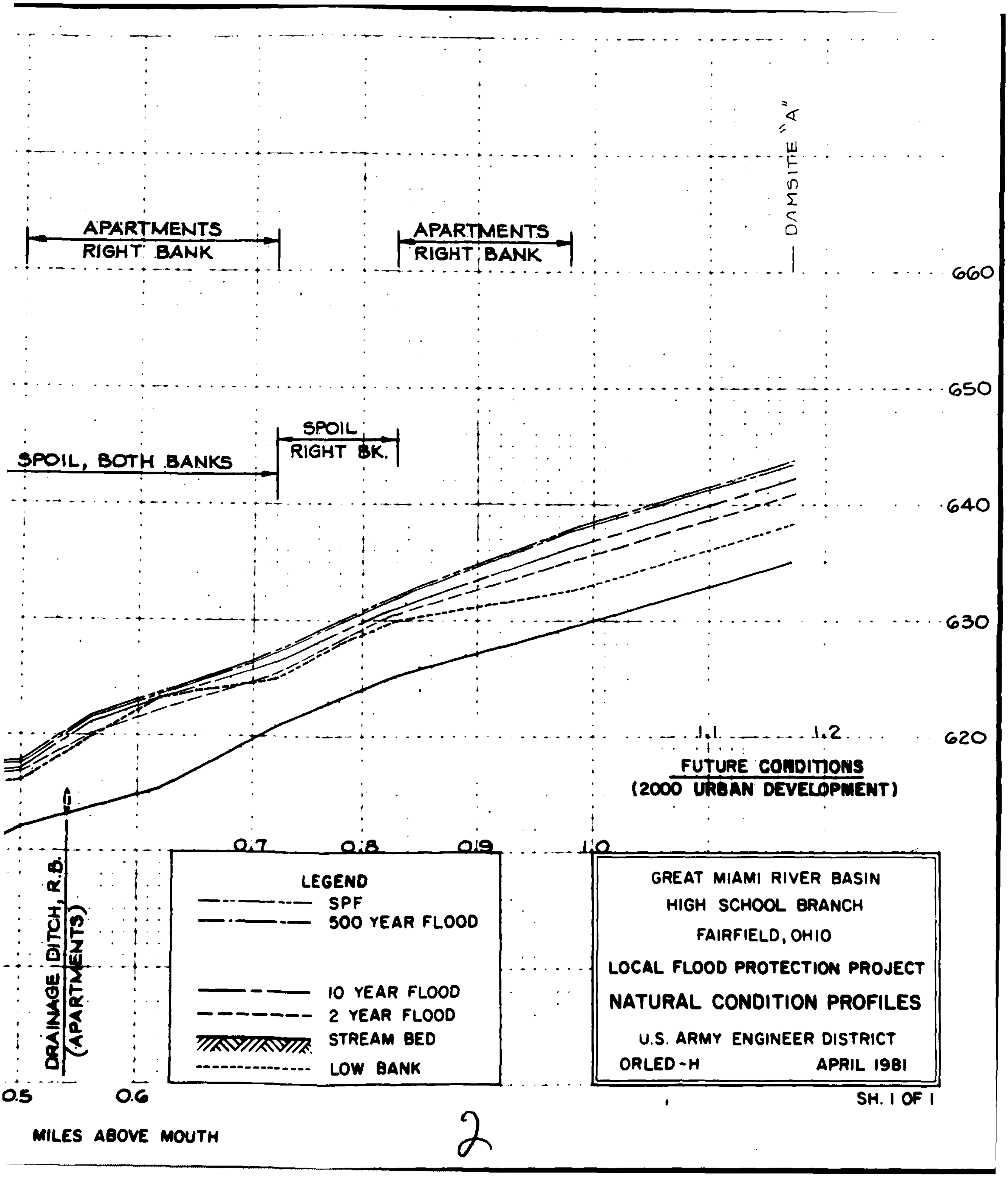

CRYSTAL DRIVE
WINTON ROAD
APARTMENTS
RIGHT BANK
SPOIL, BOTH BANKS
NOTE: PLOTTED PROFILES DO NOT REFLECT FLOODING BETWEEN MILES 0.50 AND 0.72 IN RIGHT OVERBANK (SEE ELEVATION - FREQUENCY CURVES).
ELEVATION IN FEET (N.G.V.D.)
640
630
620
610
600
590
DRAINAGE DITCH, R.B. (APARTMENTS)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
MILES ABOVE MOUTH



DAM SITE "A"
APARTMENTS RIGHT BANK
APARTMENTS RIGHT BANK
660
650
SPOIL RIGHT BK.
SPOIL, BOTH BANKS
640
630
620
PRESENT CONDITIONS
(1979 URBAN DEVELOPMENT)
DRAINAGE DITCH, R.B. (APARTMENTS)
0.5
0.6
0.7
0.8
0.9
1.0
MILES ABOVE MOUTH
LEGEND
SPF
500 YEAR FLOOD
10 YEAR FLOOD
2 YEAR FLOOD
STREAM BED
LOW BANK
GREAT MIAMI RIVER BASIN
HIGH SCHOOL BRANCH
FAIRFIELD, OHIO
LOCAL FLOOD PROTECTION PROJECT
NATURAL CONDITION PROFILES
U.S. ARMY ENGINEER DISTRICT
ORLED-H
APRIL 1981
SH. 1 OF 1

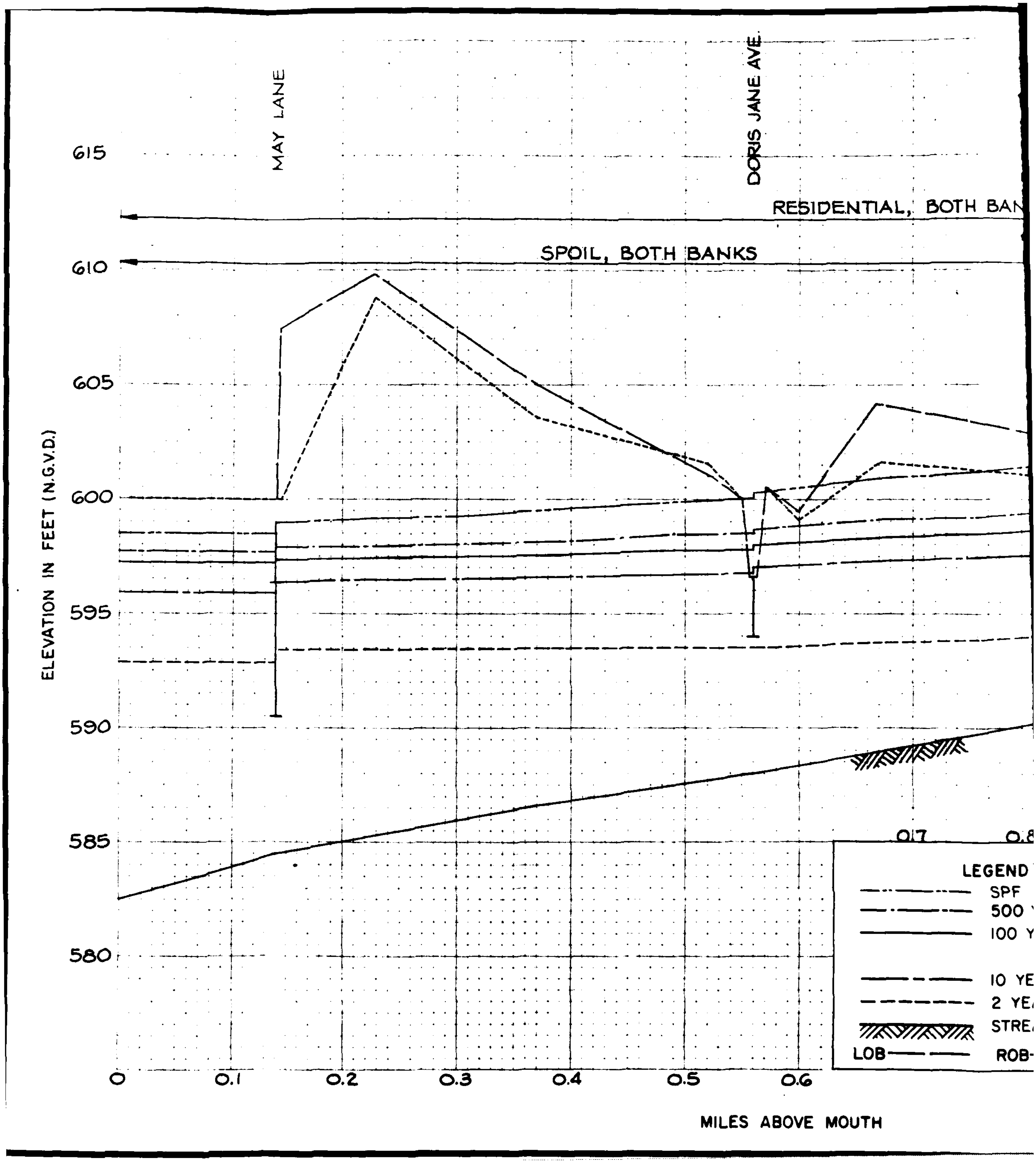


CRYSTAL DRIVE
WINTON ROAD
APARTMENTS
RIGHT BANK
SPOIL
RIGHT
SPOIL, BOTH BANKS
NOTE: PLOTTED PROFILES DO NOT REFLECT FLOODING BETWEEN MILES 0.50 AND 0.72 IN RIGHT OVERBANK (SEE ELEVATION - FREQUENCY CURVES).
ELEVATION IN FEET (N.G.V.D.)
640
630
620
610
600
590
DRAINAGE DITCH, R.B. (APARTMENTS)
LEGE
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
MILES ABOVE MOUTH



APARTMENTS RIGHT BANK
APARTMENTS RIGHT BANK
DAMSITE "A"
SPOIL, BOTH BANKS
SPOIL RIGHT BK.
660
650
640
630
620
1.1
1.2
FUTURE CONDITIONS
(2000 URBAN DEVELOPMENT)
0.7
0.8
0.9
1.0
DRAINAGE DITCH, R.B. (APARTMENTS)
LEGEND
SPF
500 YEAR FLOOD
10 YEAR FLOOD
2 YEAR FLOOD
STREAM BED
LOW BANK
GREAT MIAMI RIVER BASIN
HIGH SCHOOL BRANCH
FAIRFIELD, OHIO
LOCAL FLOOD PROTECTION PROJECT
NATURAL CONDITION PROFILES
U.S. ARMY ENGINEER DISTRICT
ORLED-H
APRIL 1981
0.5
0.6
SH. 1 OF 1
MILES ABOVE MOUTH

2



MAY LANE
DORIS JANE AVE.
RESIDENTIAL, BOTH BAN
SPOIL, BOTH BANKS
615
610
605
600
595
590
585
580
ELEVATION IN FEET (N.G.V.D.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
MILES ABOVE MOUTH
LEGEND
SPF
500
100 Y
10 YE
2 YE
STRE
LOB
ROB

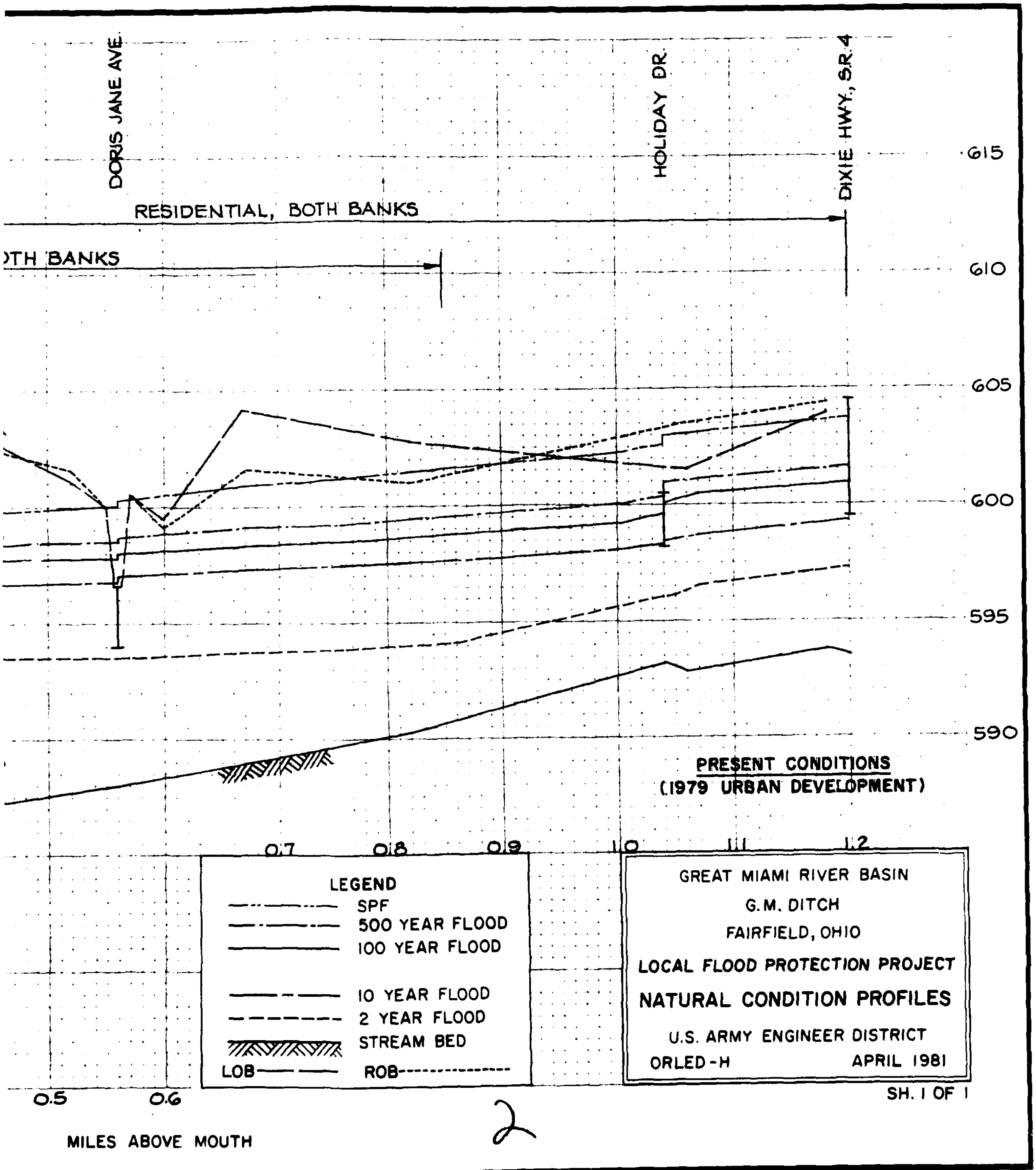
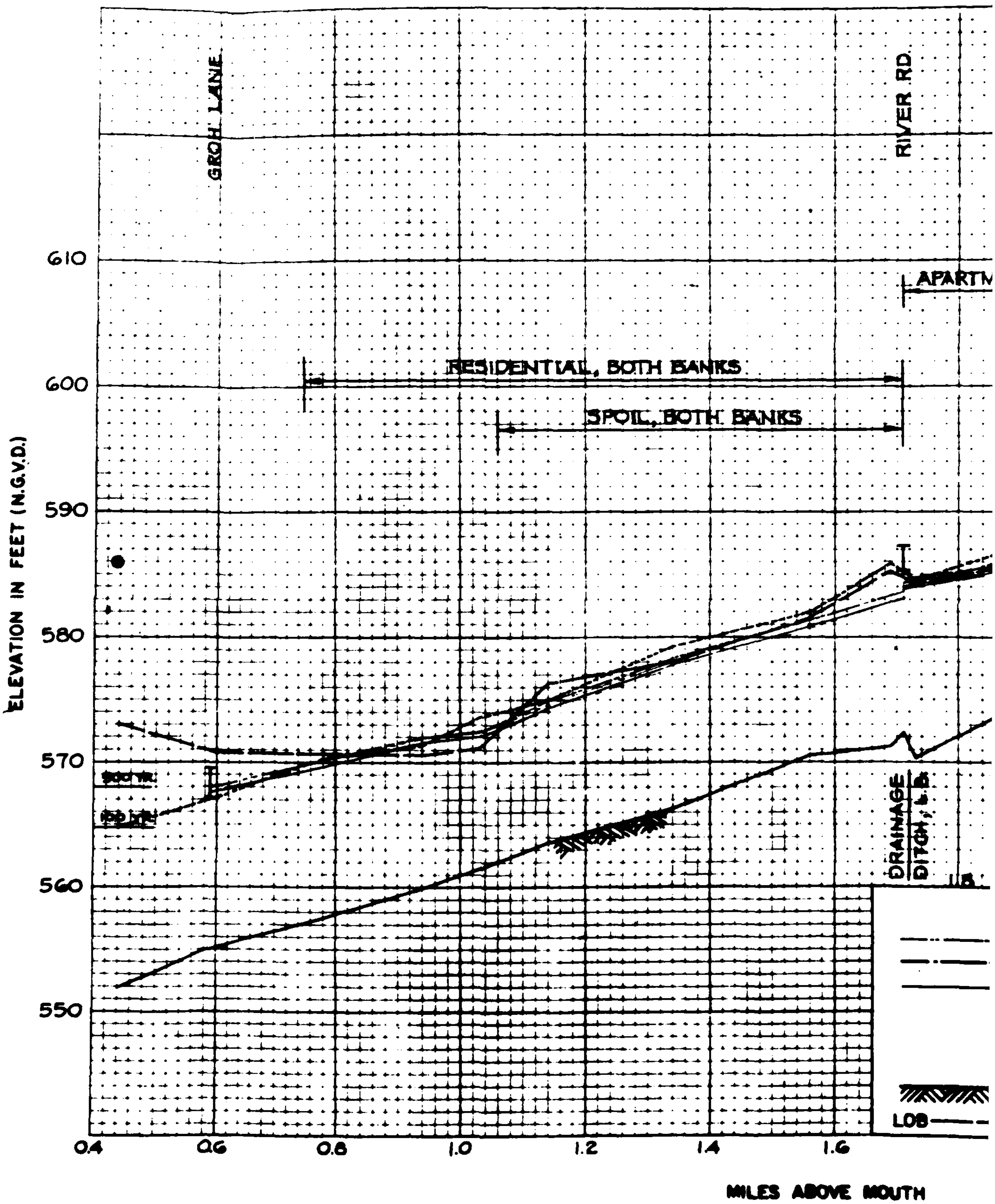
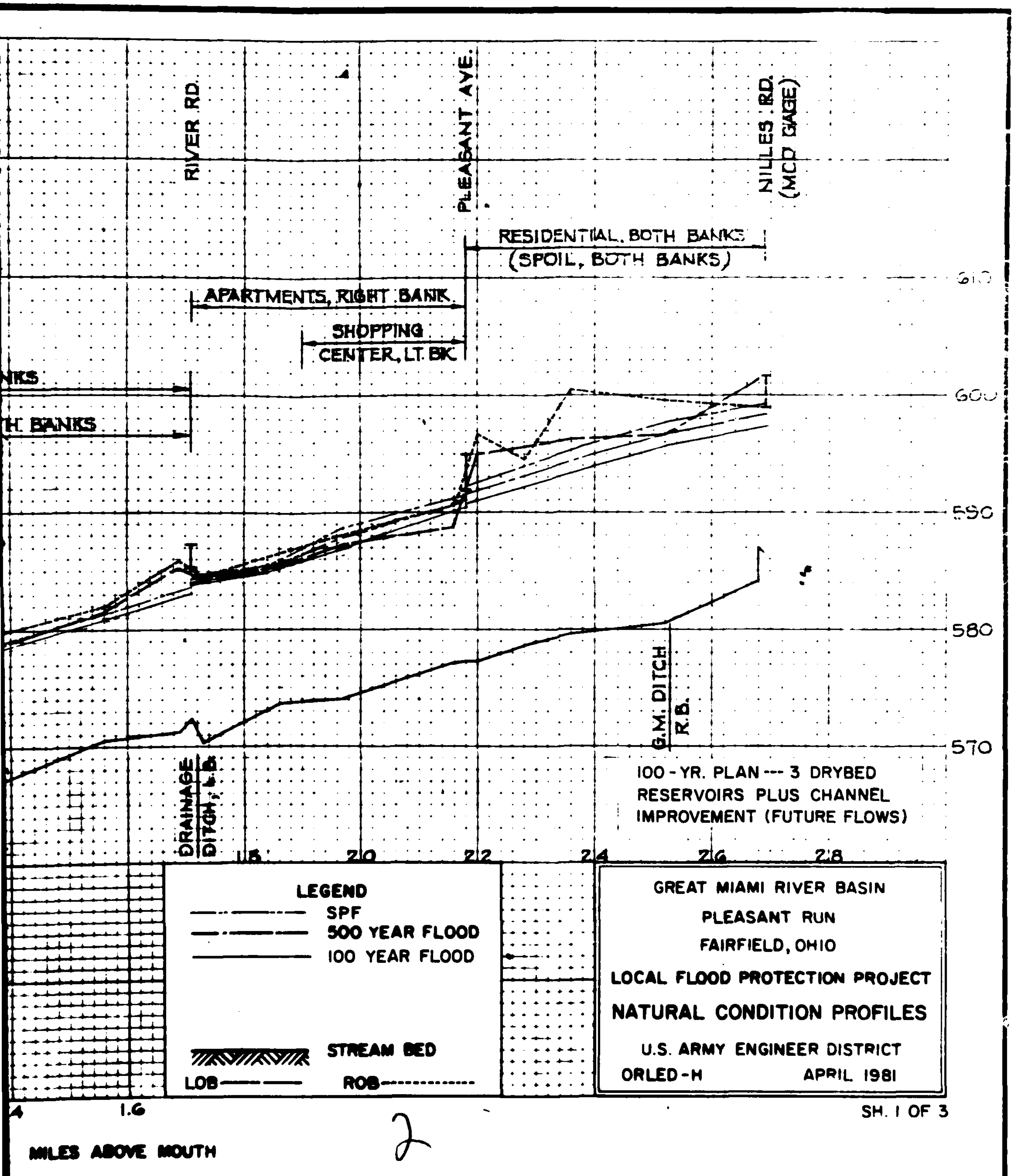

DORIS JANE AVE
HOLIDAY DR.
DIXIE HWY., S.R. 4
RESIDENTIAL, BOTH BANKS
)TH BANKS
615
610
605
600
595
590
PRESENT CONDITIONS
(1979 URBAN DEVELOPMENT)
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
MILES ABOVE MOUTH
LEGEND
SPF
500 YEAR FLOOD
100 YEAR FLOOD
10 YEAR FLOOD
2 YEAR FLOOD
STREAM BED
LOB
ROB
GREAT MIAMI RIVER BASIN
G.M. DITCH
FAIRFIELD, OHIO
LOCAL FLOOD PROTECTION PROJECT
NATURAL CONDITION PROFILES
U.S. ARMY ENGINEER DISTRICT
ORLED-H
APRIL 1981
SH. 1 OF 1
2

PLATE D-57



GROH LANE
RIVER RD.
APARTM
RESIDENTIAL, BOTH BANKS
SPOIL, BOTH BANKS
DRAINAGE DITCH, L.B.
610
600
590
580
570
560
550
ELEVATION IN FEET (N.G.V.D.)
0.4
0.6
0.8
1.0
1.2
1.4
1.6
MILES ABOVE MOUTH
LOB



GREAT MIAMI RIVER BASIN

PLEASANT RUN

FAIRFIELD, OHIO

LOCAL FLOOD PROTECTION PROJECT

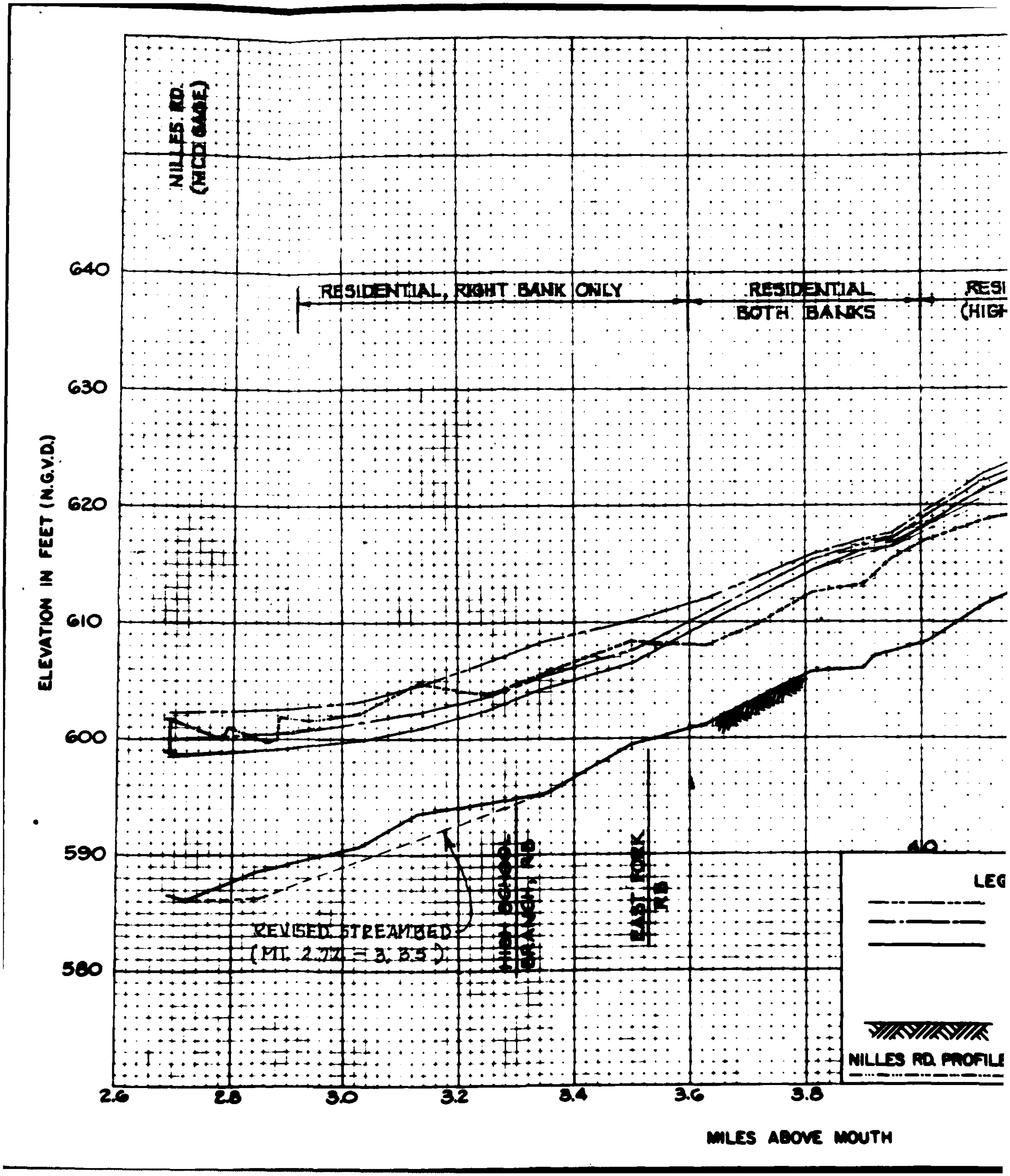
NATURAL CONDITION PROFILES

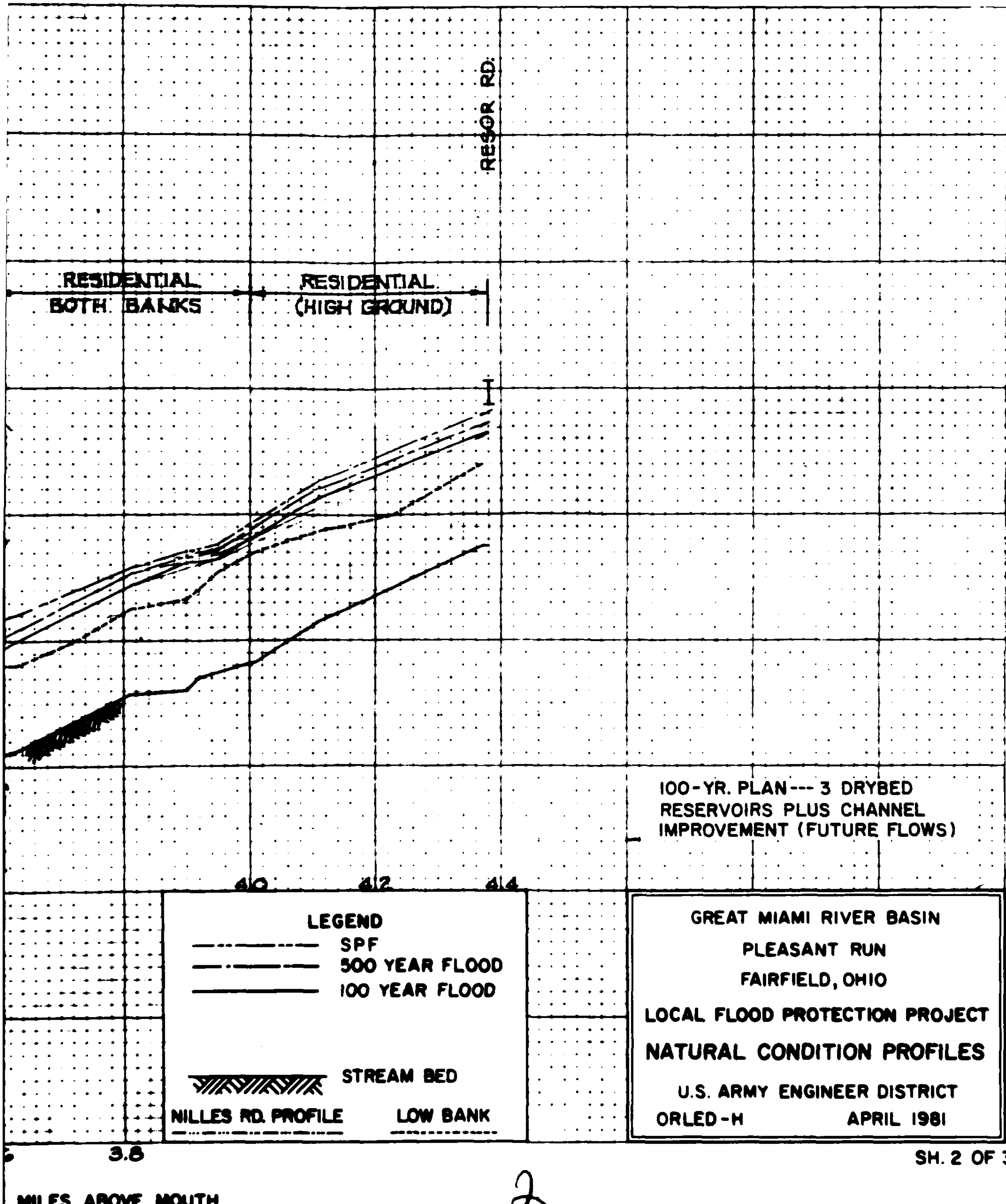
U.S. ARMY ENGINEER DISTRICT

ORLED-H APRIL 1981

SH. 1 OF 3

2


NILLES RD. (NICD GAGE)
RESIDENTIAL, RIGHT BANK ONLY
RESIDENTIAL BOTH BANKS
RESI (HIGH
640
630
620
610
600
590
580
ELEVATION IN FEET (N.G.V.D.)
HIGH SCHOOL BRANCH, RB
EAST FORK RB
REVISED STREAMBED (MI. 2.72 = 3.35)
4.0
LEG
NILLES RD. PROFIL
2.6
2.8
3.0
3.2
3.4
3.6
3.8
MILES ABOVE MOUTH



GREAT MIAMI RIVER BASIN

PLEASANT RUN

FAIRFIELD, OHIO

LOCAL FLOOD PROTECTION PROJECT

NATURAL CONDITION PROFILES

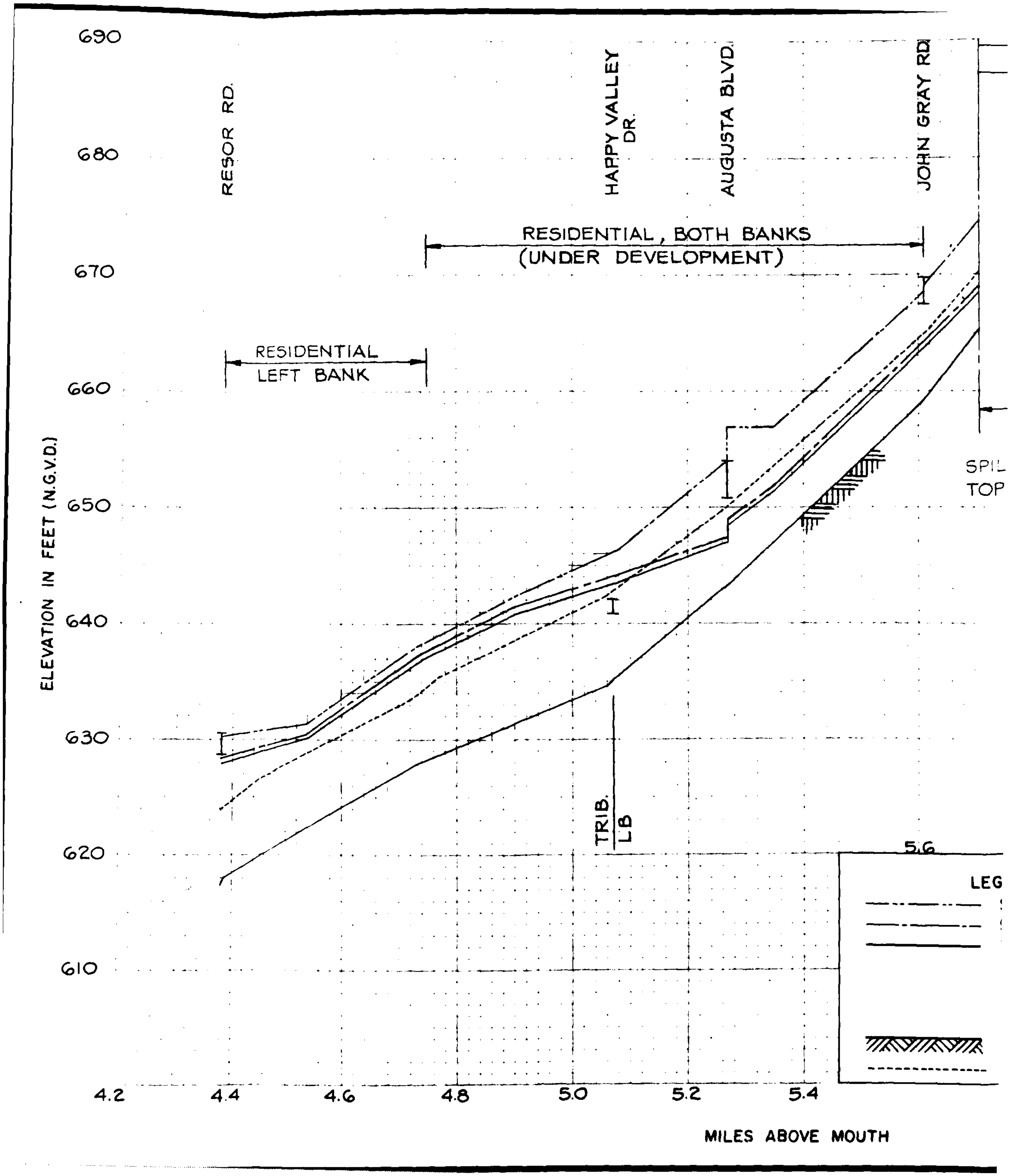
U.S. ARMY ENGINEER DISTRICT

ORLED-H APRIL 1981

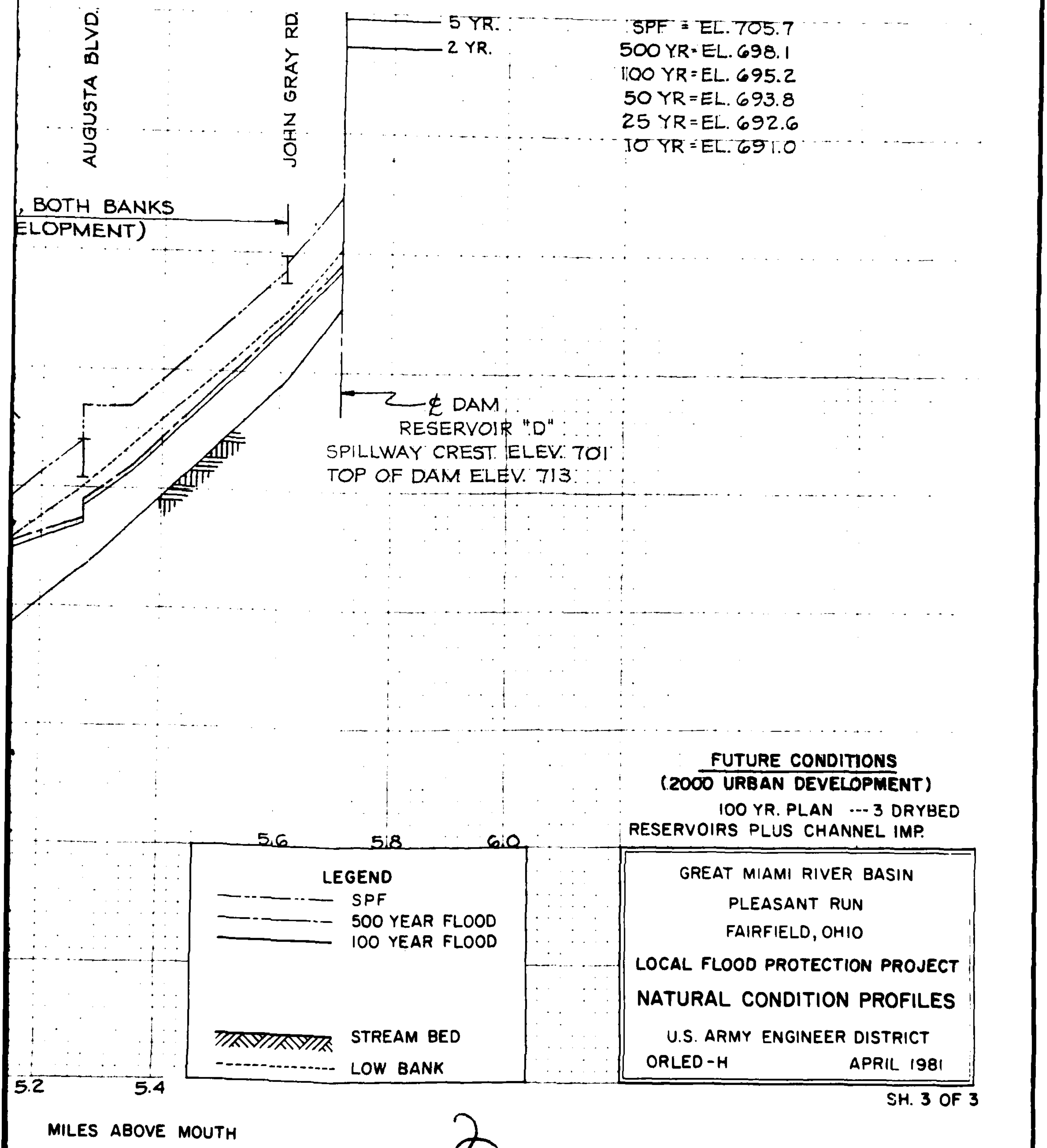
SH. 2 OF 3

2

PLATE D-59



690
680
670
660
650
640
630
620
610
ELEVATION IN FEET (N.G.V.D.)
RESOR RD.
HAPPY VALLEY DR.
AUGUSTA BLVD.
JOHN GRAY RD.
RESIDENTIAL, BOTH BANKS (UNDER DEVELOPMENT)
RESIDENTIAL LEFT BANK
TRIB. LB
SPIL
TOP
LEG
4.2
4.4
4.6
4.8
5.0
5.2
5.4
5.6
MILES ABOVE MOUTH



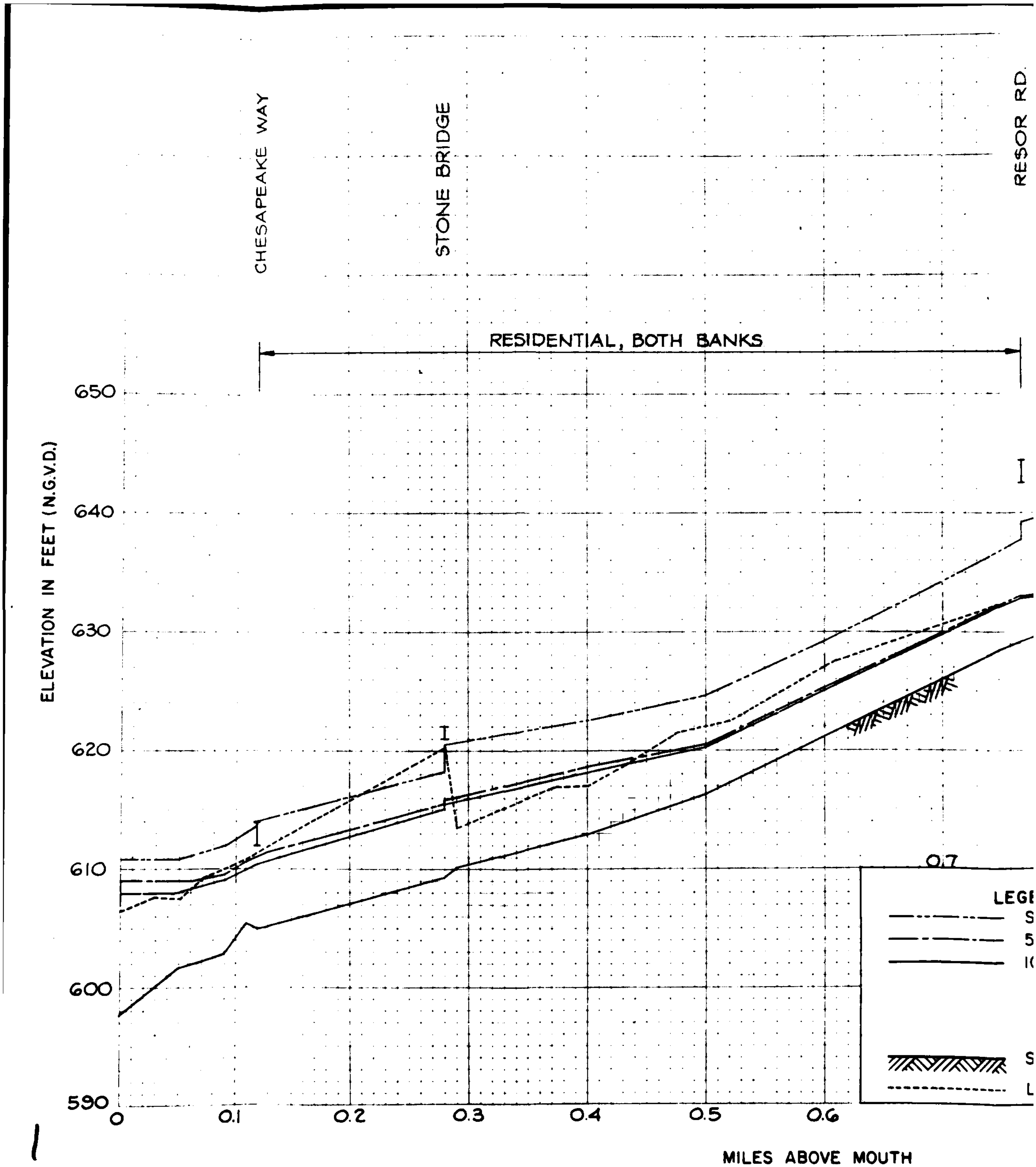
FUTURE CONDITIONS
(2000 URBAN DEVELOPMENT)
100 YR. PLAN --- 3 DRYBED
RESERVOIRS PLUS CHANNEL IMP.

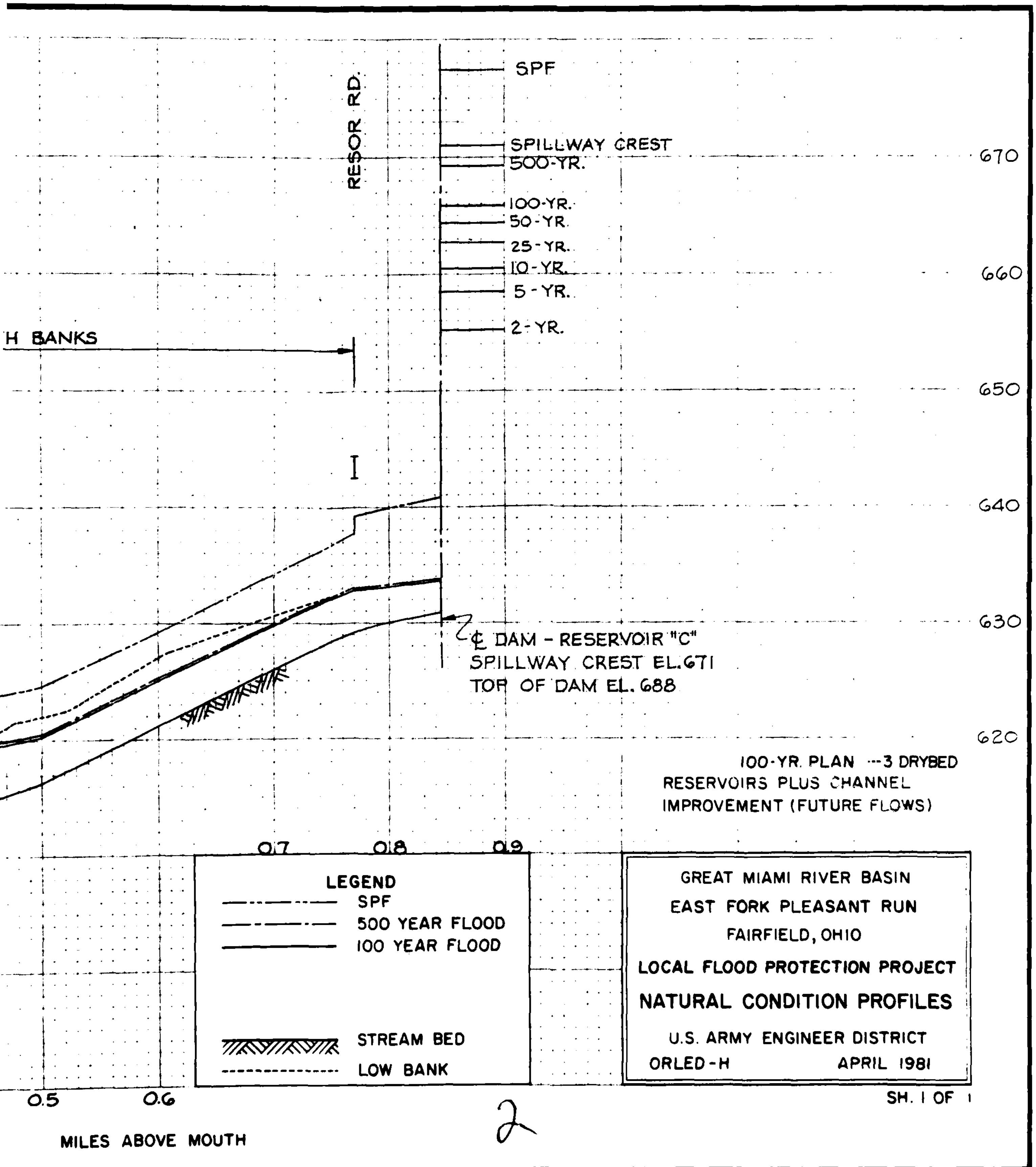
GREAT MIAMI RIVER BASIN
PLEASANT RUN
FAIRFIELD, OHIO
LOCAL FLOOD PROTECTION PROJECT
NATURAL CONDITION PROFILES
U.S. ARMY ENGINEER DISTRICT
ORLED-H APRIL 1981

SH. 3 OF 3

2

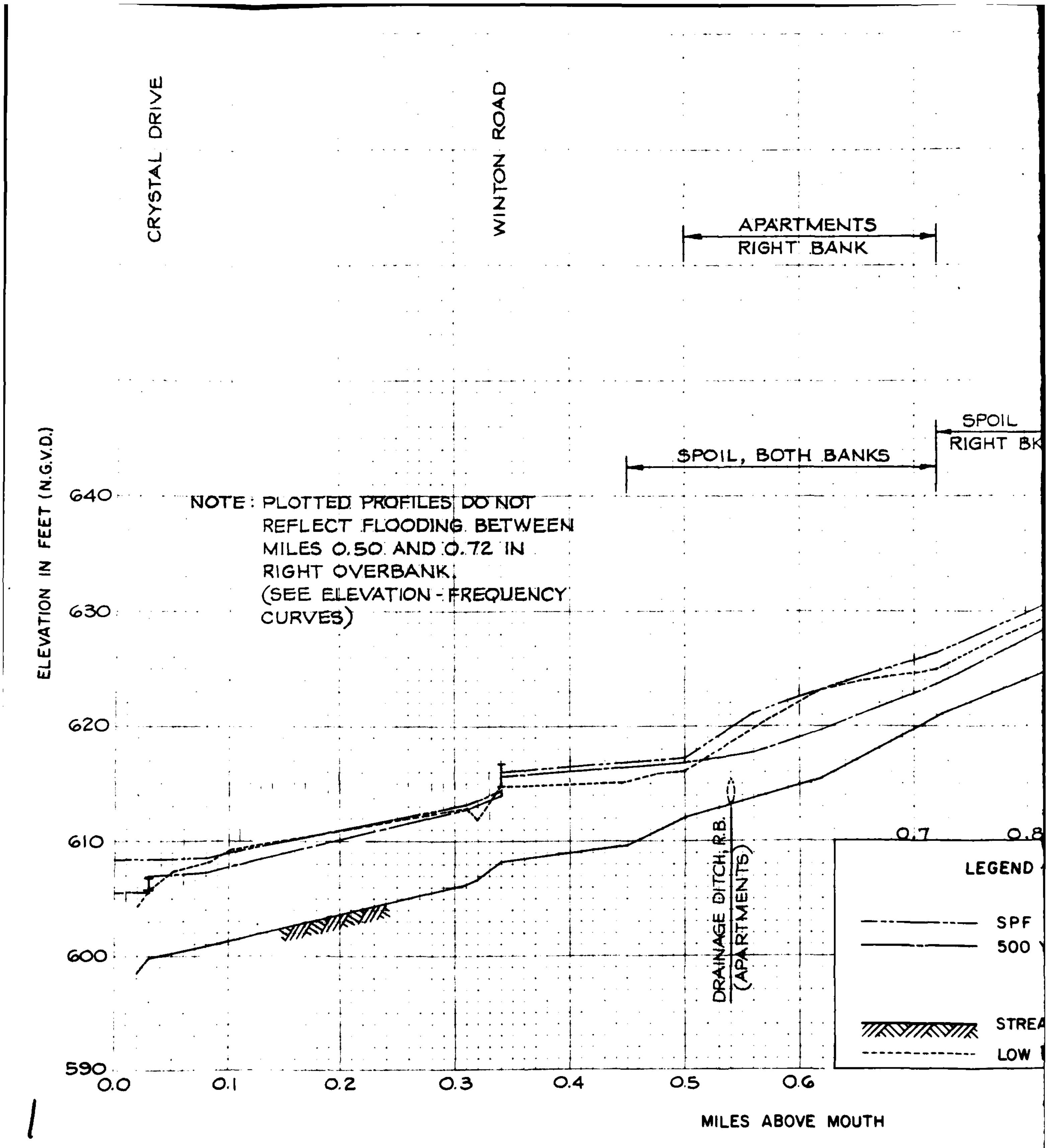
PLATE L-60


CHESAPEAKE WAY
STONE BRIDGE
RESOR RD.
RESIDENTIAL, BOTH BANKS
ELEVATION IN FEET (N.G.V.D.)
650
640
630
620
610
600
590
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
MILES ABOVE MOUTH
LEGE
1



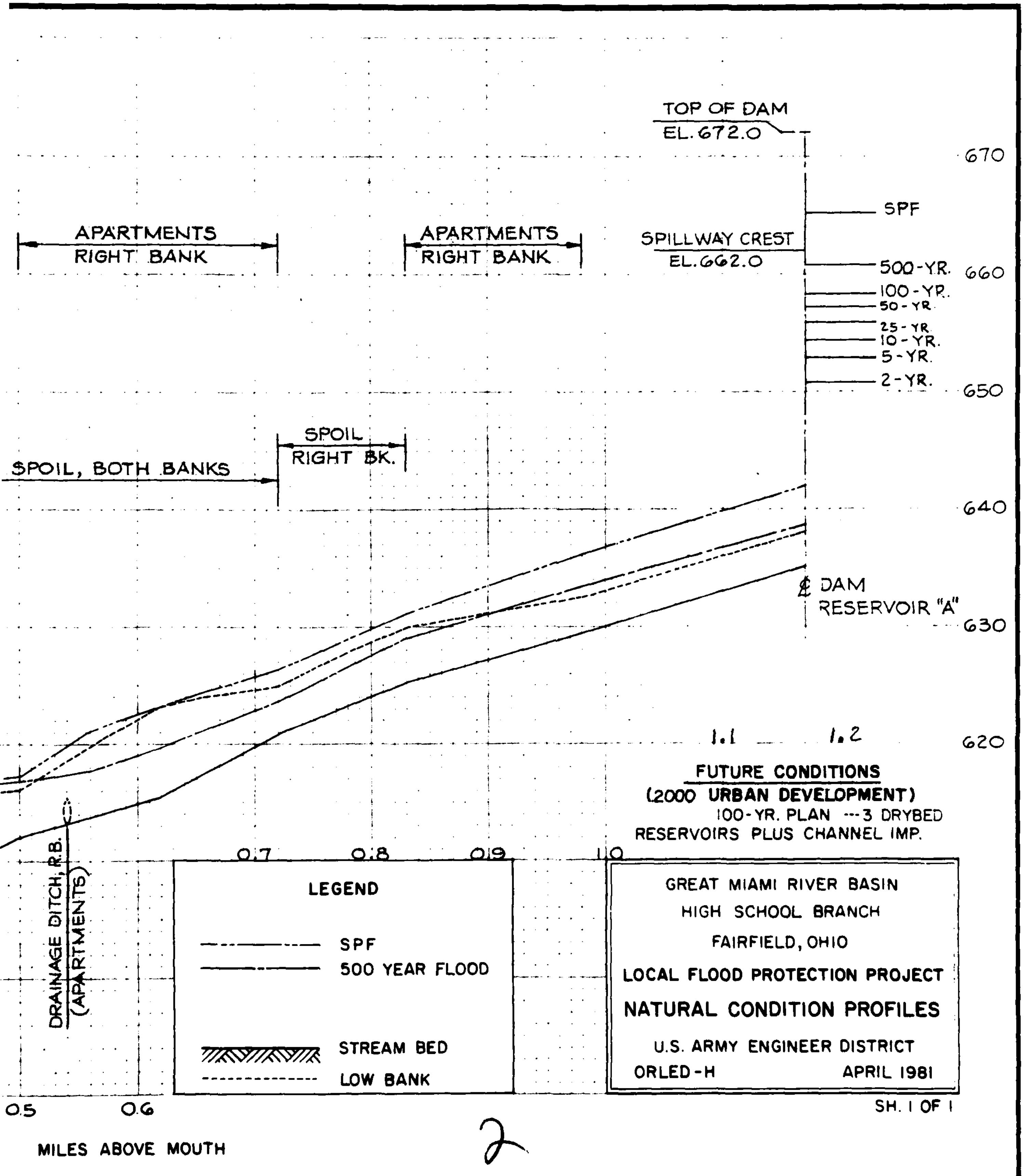
SPF
RESOR RD.
SPILLWAY CREST
500-YR.
100-YR.
50-YR.
25-YR.
10-YR.
5-YR.
2-YR.
H BANKS
I
670
660
650
640
630
620
℄ DAM - RESERVOIR "C"
SPILLWAY CREST EL. 671
TOP OF DAM EL. 688
100-YR. PLAN ---3 DRYBED RESERVOIRS PLUS CHANNEL IMPROVEMENT (FUTURE FLOWS)
0.5
0.6
0.7
0.8
0.9
MILES ABOVE MOUTH
LEGEND
SPF
500 YEAR FLOOD
100 YEAR FLOOD
STREAM BED
LOW BANK
GREAT MIAMI RIVER BASIN
EAST FORK PLEASANT RUN
FAIRFIELD, OHIO
LOCAL FLOOD PROTECTION PROJECT
NATURAL CONDITION PROFILES
U.S. ARMY ENGINEER DISTRICT
ORLED-H
APRIL 1981
SH. 1 OF 1
2

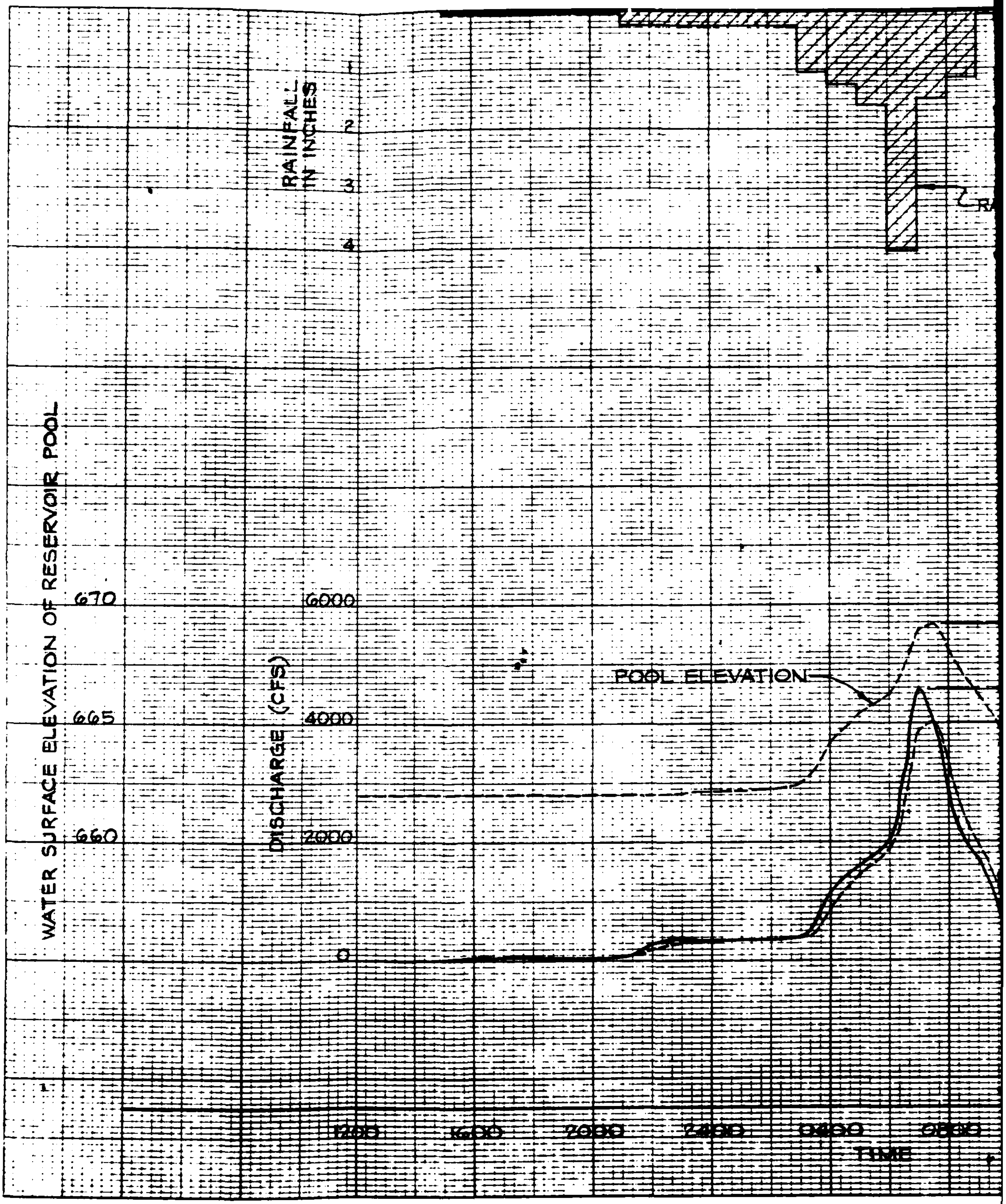
PL. 21

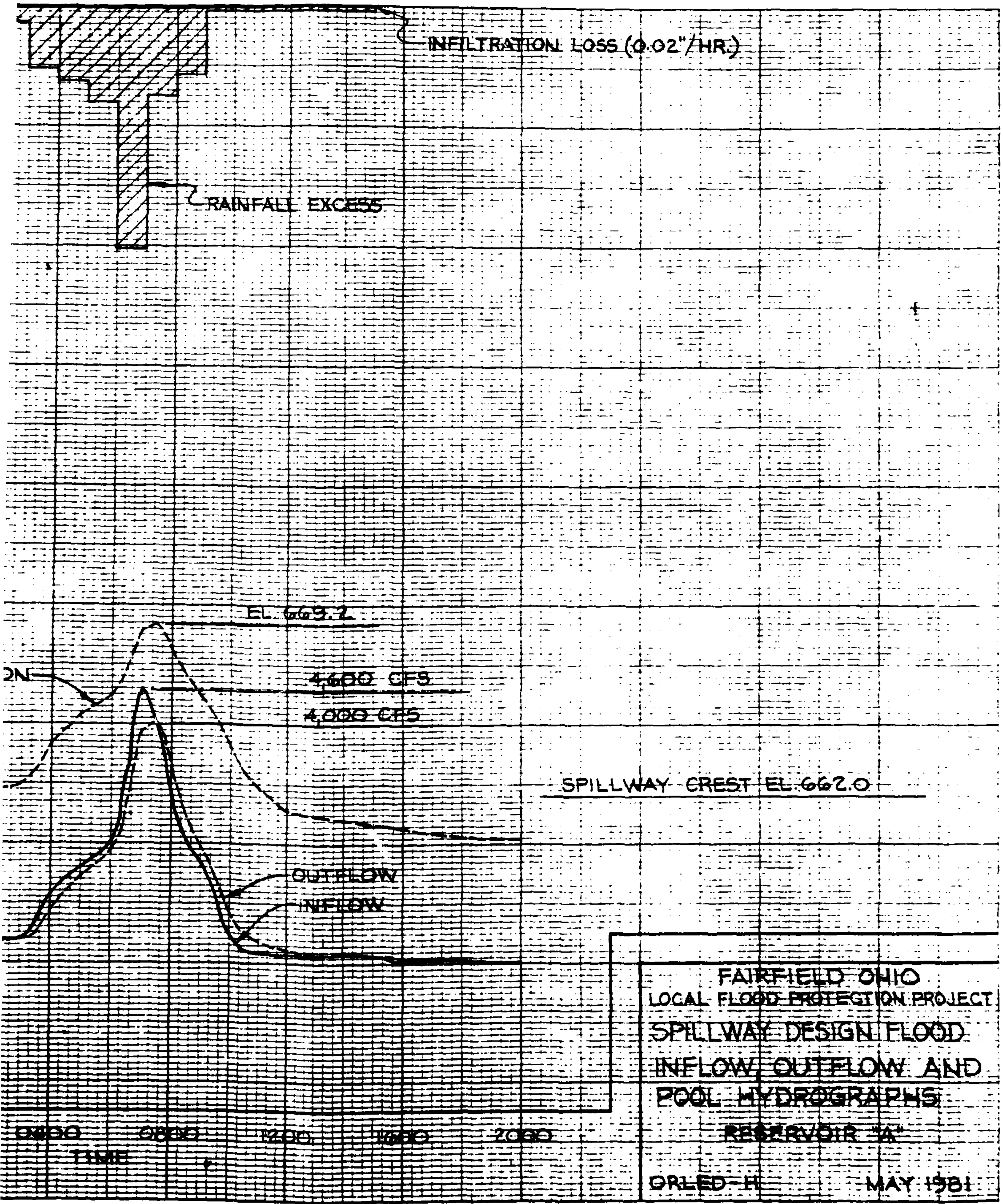


CRYSTAL DRIVE
WINTON ROAD
APARTMENTS
RIGHT BANK
SPOIL
RIGHT BK
SPOIL, BOTH BANKS
NOTE: PLOTTED PROFILES DO NOT REFLECT FLOODING BETWEEN MILES 0.50 AND 0.72 IN RIGHT OVERBANK. (SEE ELEVATION-FREQUENCY CURVES)
ELEVATION IN FEET (N.G.V.D.)
640
630
620
610
600
590
DRAINAGE DITCH, R.B. (APARTMENTS)
LEGEND
SPF
500
STREA
LOW
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
MILES ABOVE MOUTH

1


TOP OF DAM
EL. 672.0
SPF
SPILLWAY CREST
EL. 662.0
500-YR.
100-YR.
50-YR.
25-YR.
10-YR.
5-YR.
2-YR.
670
660
650
640
630
620
APARTMENTS
RIGHT BANK
APARTMENTS
RIGHT BANK
SPOIL
RIGHT BK.
SPOIL, BOTH BANKS
℄ DAM
RESERVOIR "A"
1.1
1.2
FUTURE CONDITIONS
(2000 URBAN DEVELOPMENT)
100-YR. PLAN ---3 DRYBED
RESERVOIRS PLUS CHANNEL IMP.
DRAINAGE DITCH, R.B.
(APARTMENTS)
0.7
0.8
0.9
1.0
LEGEND
SPF
500 YEAR FLOOD
STREAM BED
LOW BANK
GREAT MIAMI RIVER BASIN
HIGH SCHOOL BRANCH
FAIRFIELD, OHIO
LOCAL FLOOD PROTECTION PROJECT
NATURAL CONDITION PROFILES
U.S. ARMY ENGINEER DISTRICT
ORLED-H
APRIL 1981
SH. 1 OF 1
0.5
0.6
MILES ABOVE MOUTH
2


RAINFALL IN INCHES
1
2
3
4
WATER SURFACE ELEVATION OF RESERVOIR POOL
670
665
660
DISCHARGE (CFS)
6000
4000
2000
0
POOL ELEVATION
1200
1600
2000
2400
0400
0800
TIME

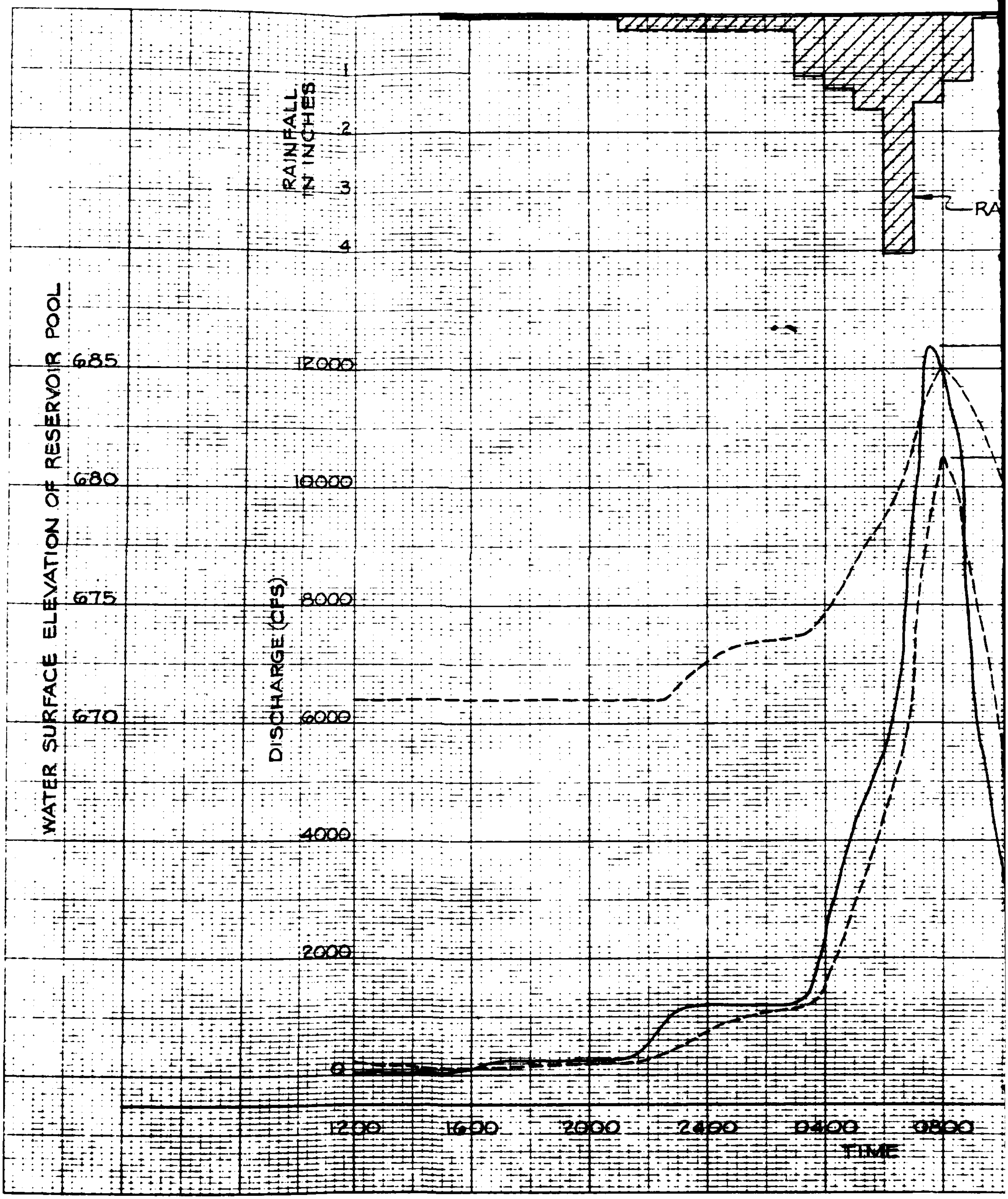


FAIRFIELD OHIO
LOCAL FLOOD PROTECTION PROJECT
SPILLWAY DESIGN FLOOD
INFLOW, OUTFLOW AND
POOL HYDROGRAPHS
RESERVOIR "A"

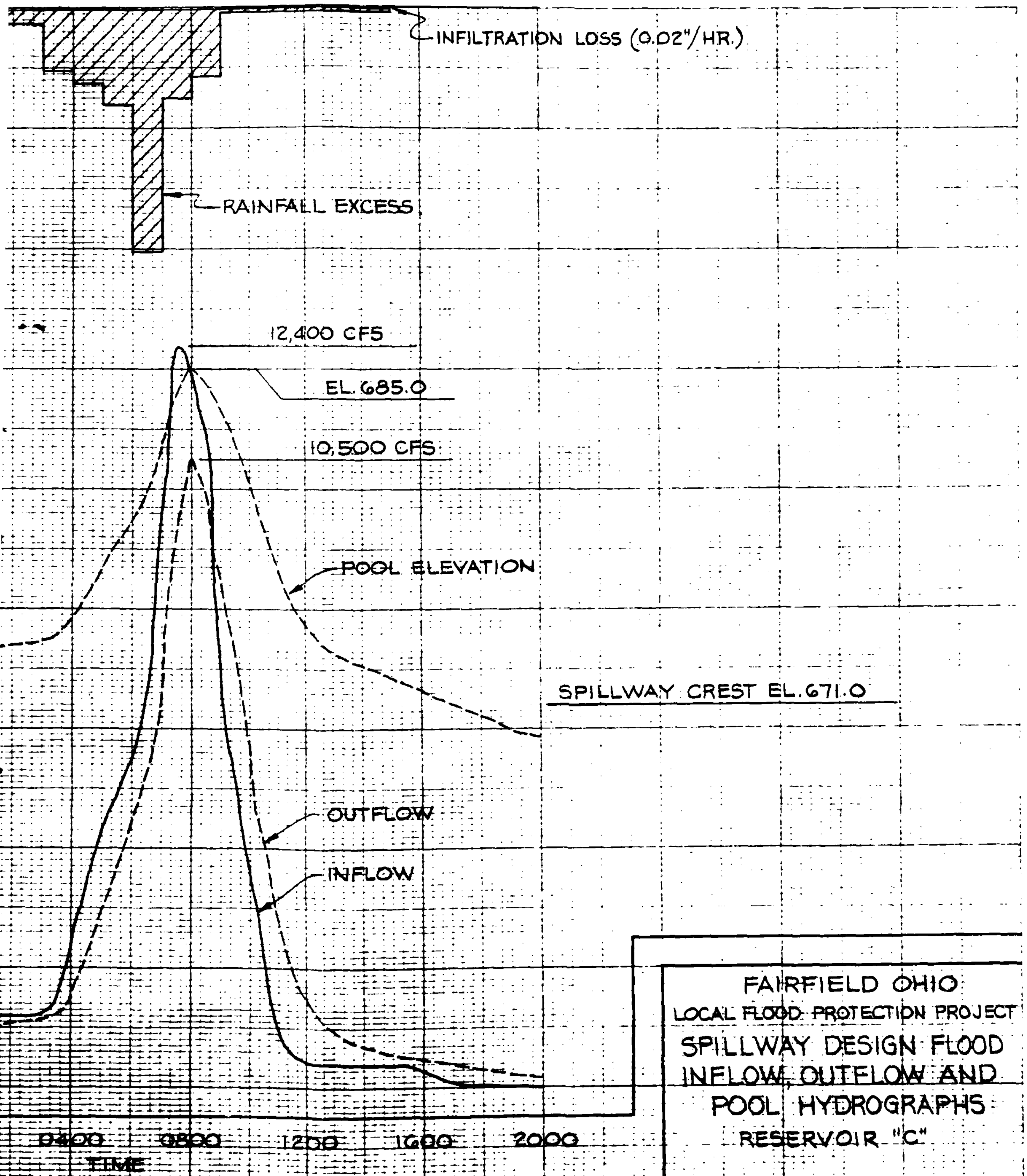
ORLED-H MAY 1981

PLATE D-63

2


RAINFALL IN INCHES
1
2
3
4
WATER SURFACE ELEVATION OF RESERVOIR POOL
685
680
675
670
DISCHARGE (CFS)
12000
10000
8000
6000
4000
2000
0
1200
1600
2000
2400
0400
0800
TIME

47 1973

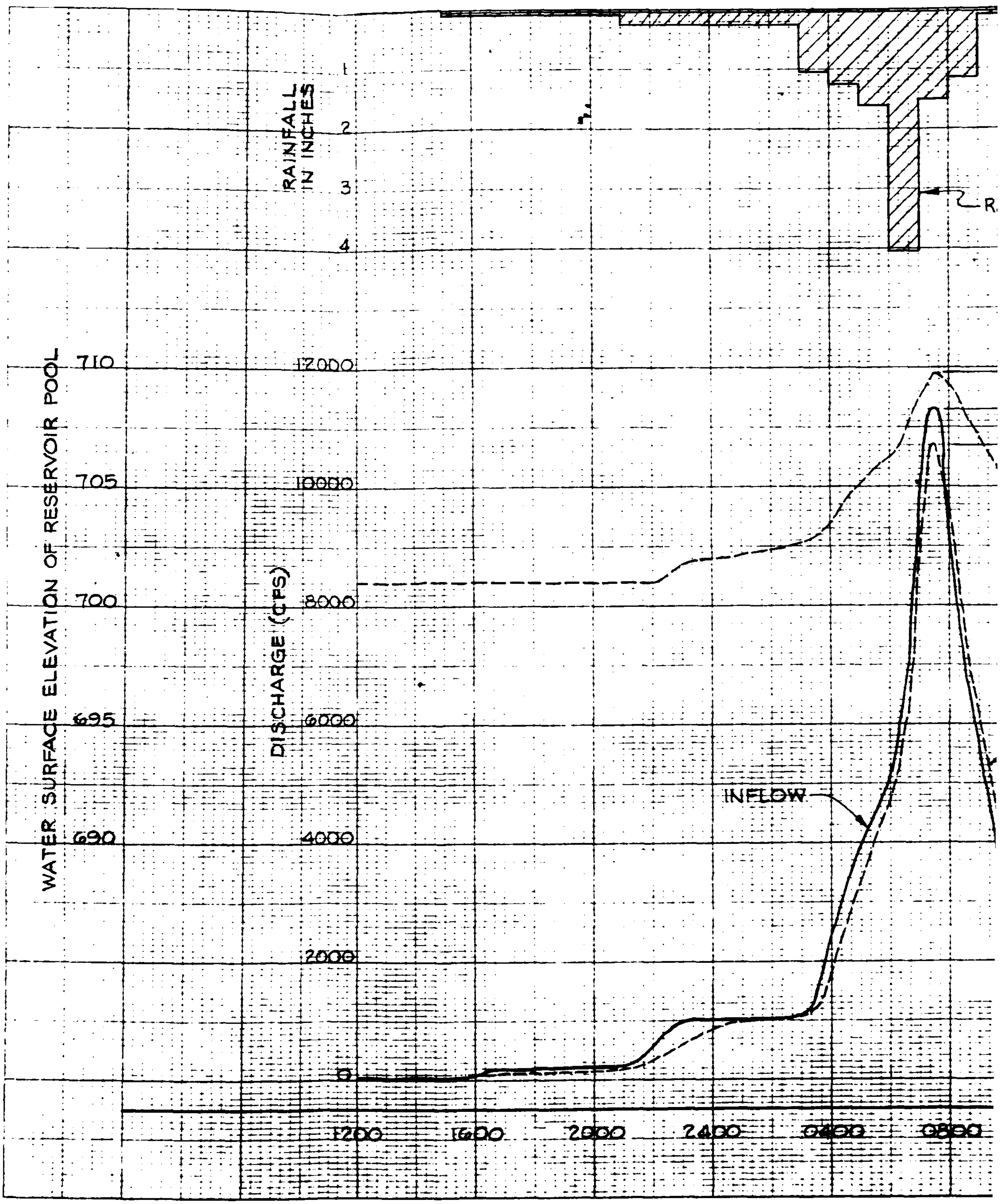


FAIRFIELD OHIO
LOCAL FLOOD PROTECTION PROJECT
SPILLWAY DESIGN FLOOD
INFLOW, OUTFLOW AND
POOL HYDROGRAPHS
RESERVOIR "C"

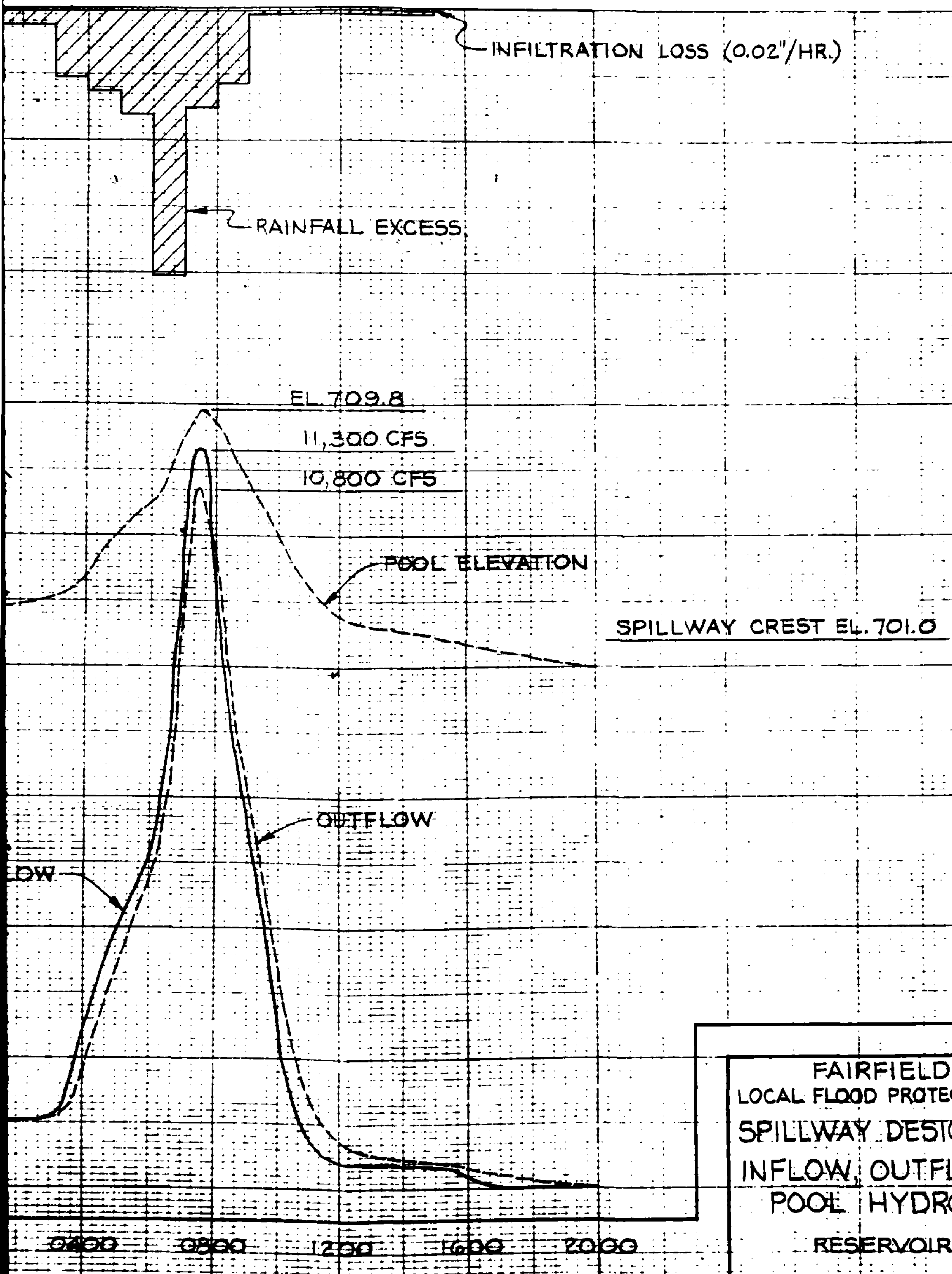
ORLED-H MAY 1981

PLATE D-64

2



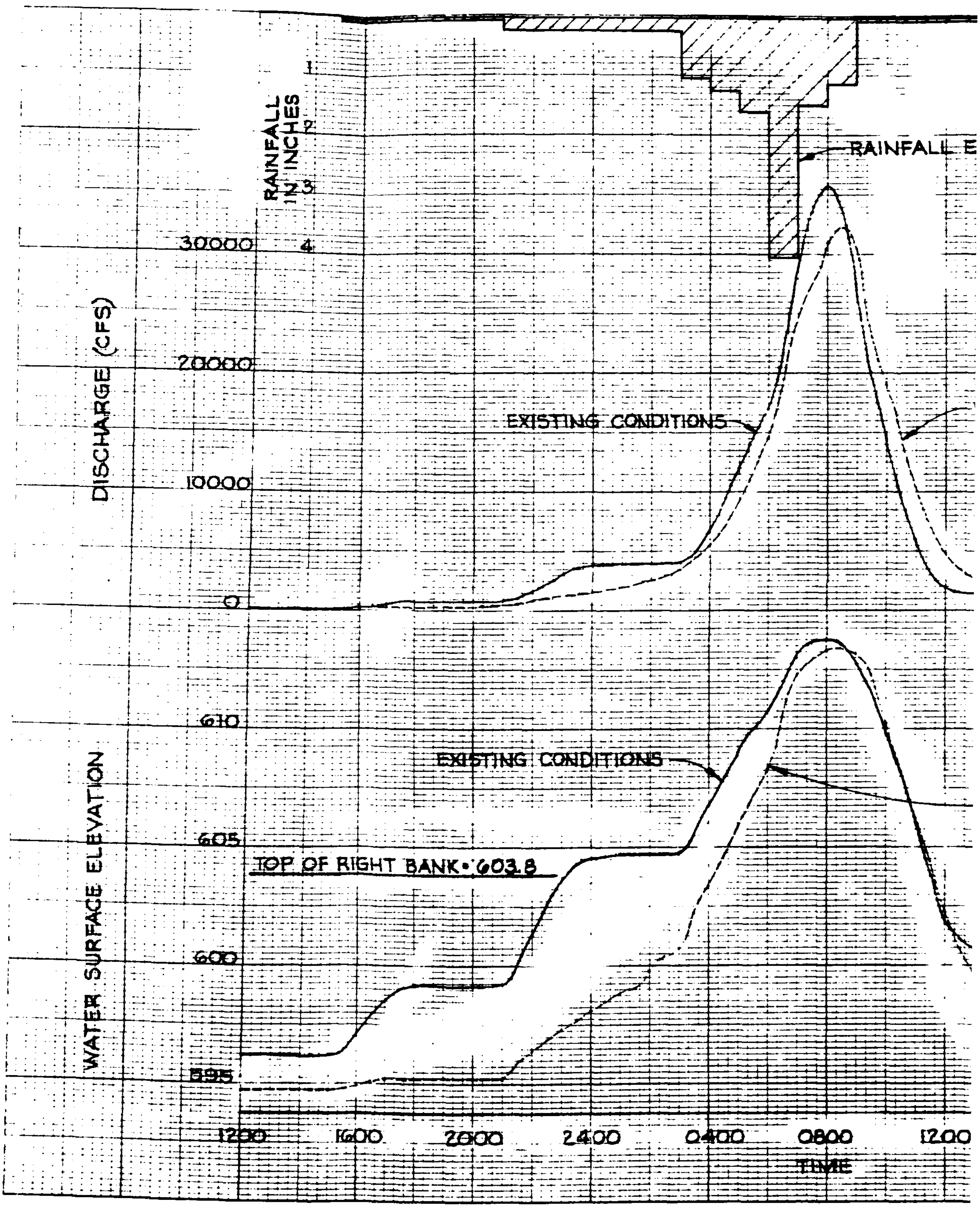
RAINFALL IN INCHES
1
2
3
4
R
WATER SURFACE ELEVATION OF RESERVOIR POOL
710
705
700
695
690
DISCHARGE (CFS)
12000
10000
8000
6000
4000
2000
0
INFLOW
1200
1600
2000
2400
0400
0800



FAIRFIELD OHIO
LOCAL FLOOD PROTECTION PROJECT
SPILLWAY DESIGN FLOOD
INFLOW, OUTFLOW AND
POOL HYDROGRAPHS
RESERVOIR "D"

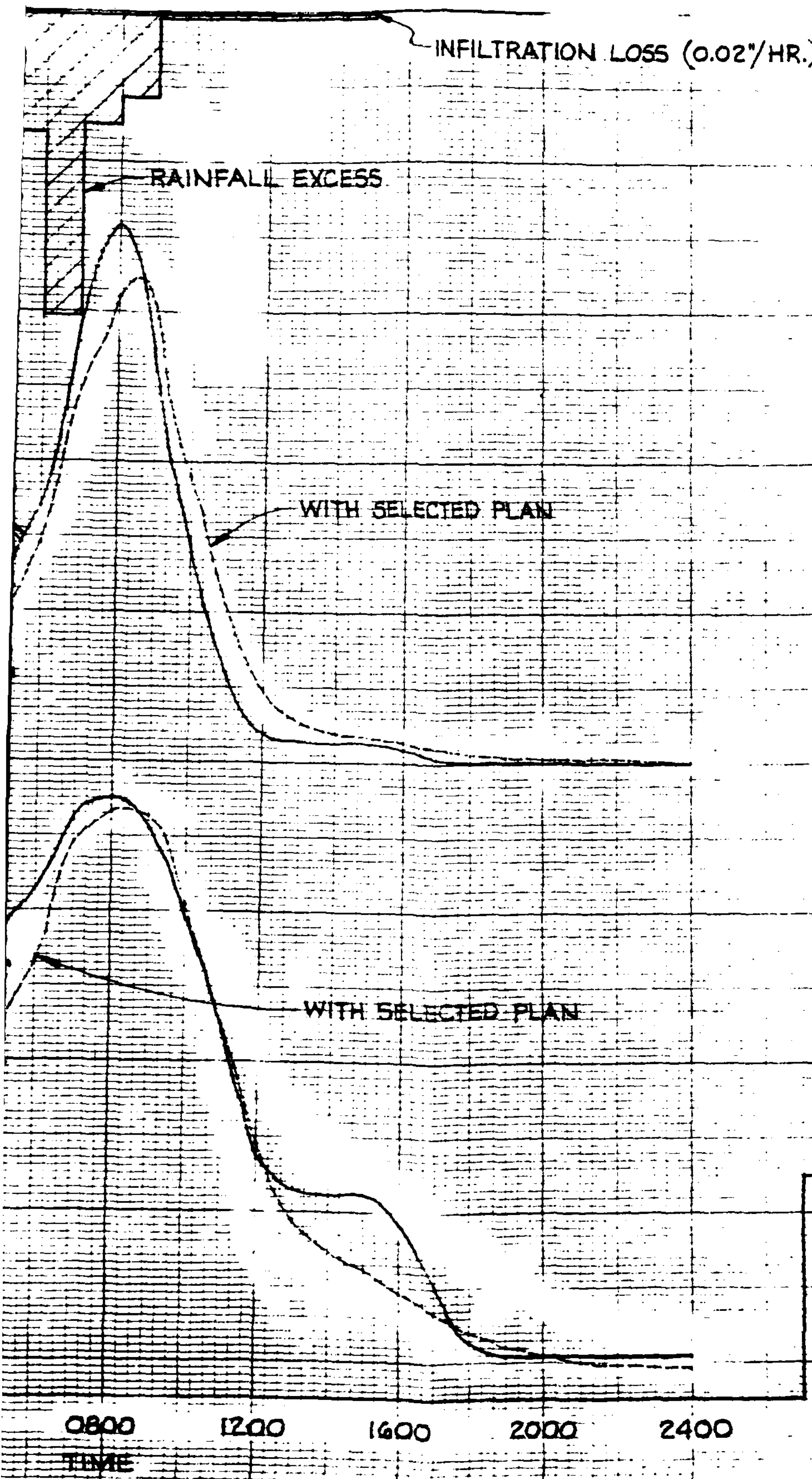
ORLED-H MAY 1981

PLATE D-65



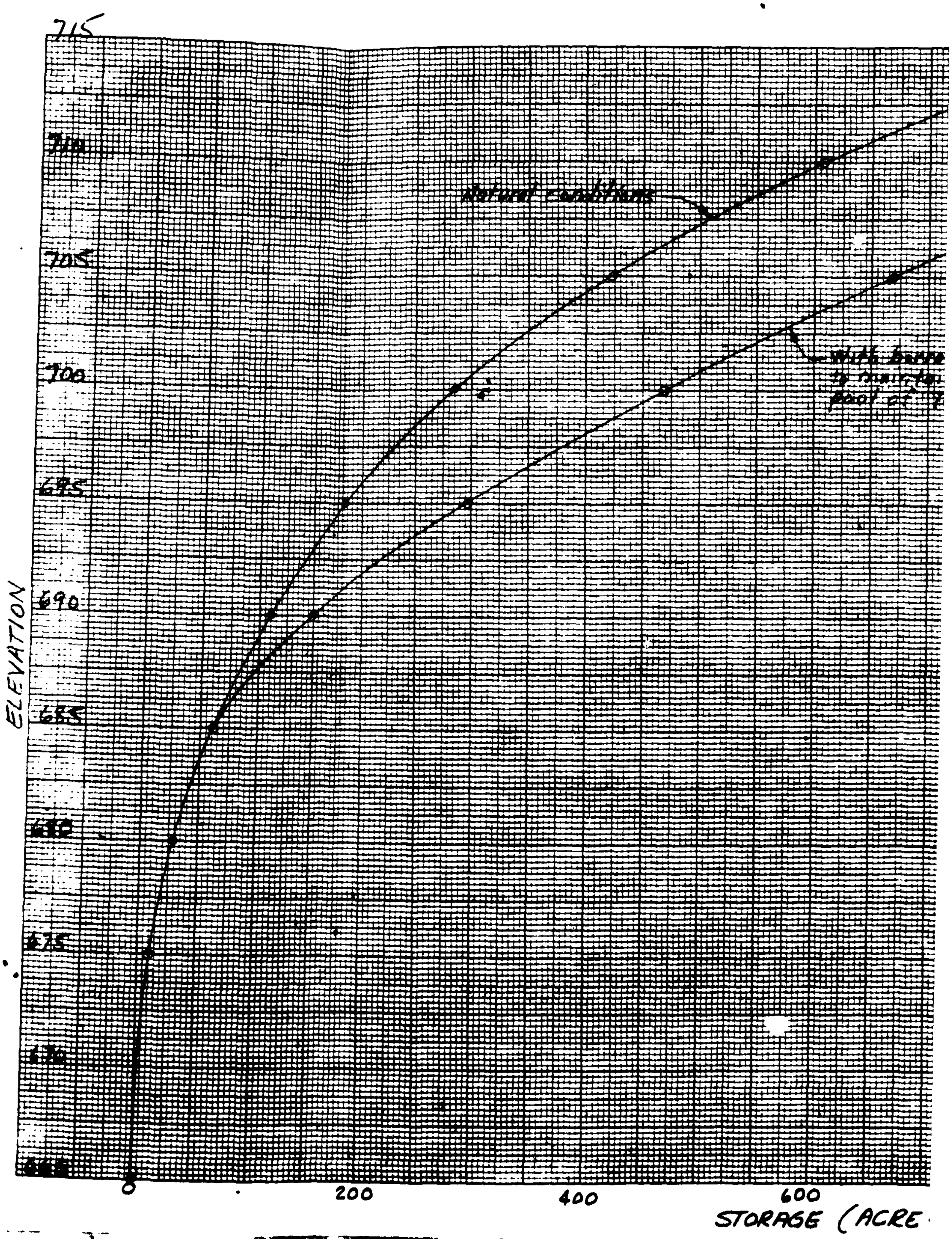
47 1973

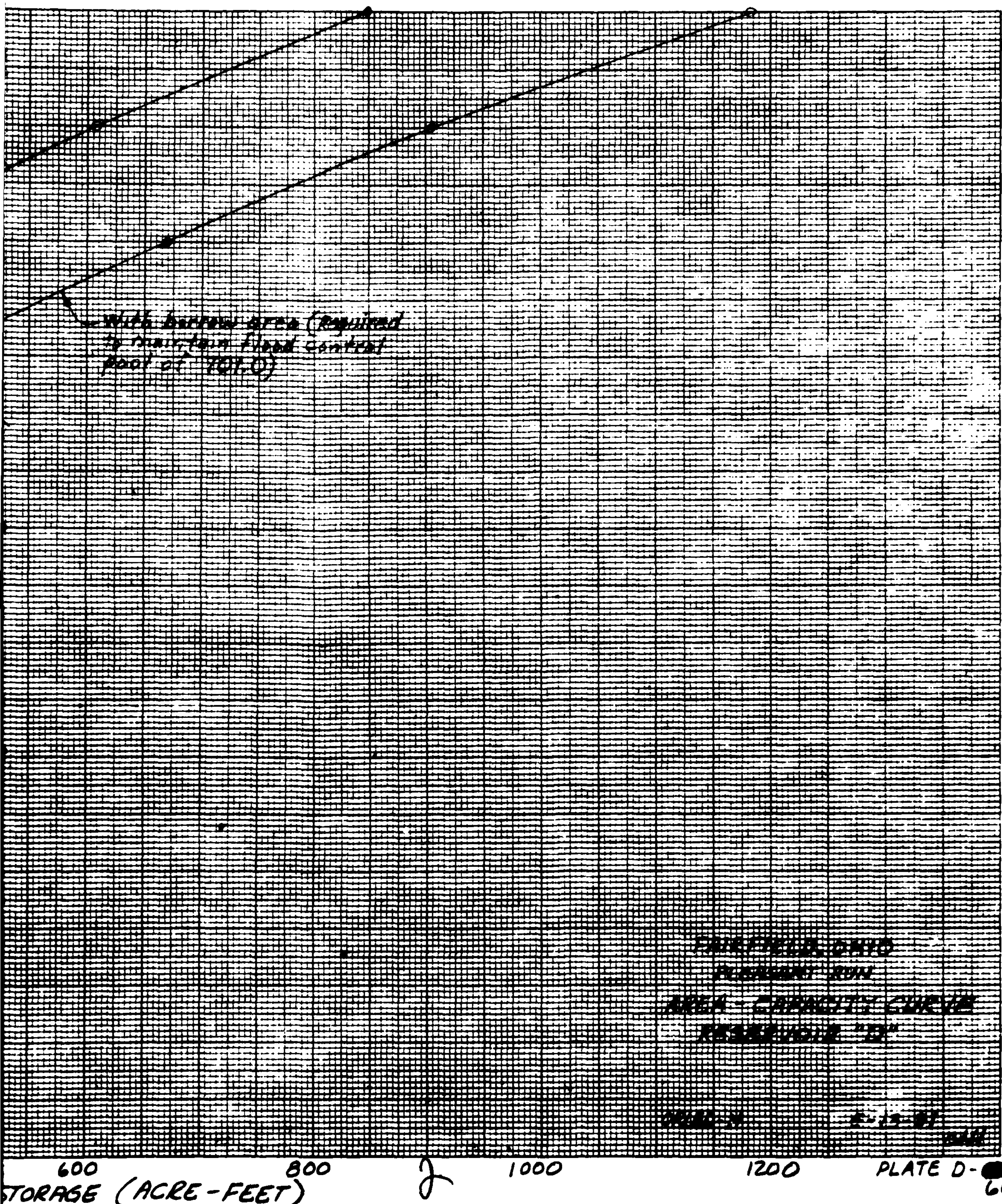
K+E 10 X 20 TO THE INCH
KEUFFEL & ESSER CO.



FAIRFIELD OHIO
LOCAL FLOOD PROTECTION PROJECT
SPILLWAY DESIGN FLOOD
DISCHARGE & ELEVATION
HYDROGRAPHS
PLEASANT RUN
MILE 3.25
ORLED-H SEP. 1981
PLATE D-65A

2


715
710
705
700
695
690
685
680
675
670
ELEVATION
Natural conditions
0
200
400
600
STORAGE (ACRE



With borrow area (Required to maintain flood control pool of 701.0)
FAIRFIELD, OHIO
PLEASANT RUN
AREA - CAPACITY CURVE
RESERVOIR "D"
600
800
1000
1200
STORAGE (ACRE-FEET)

PLATE D-66

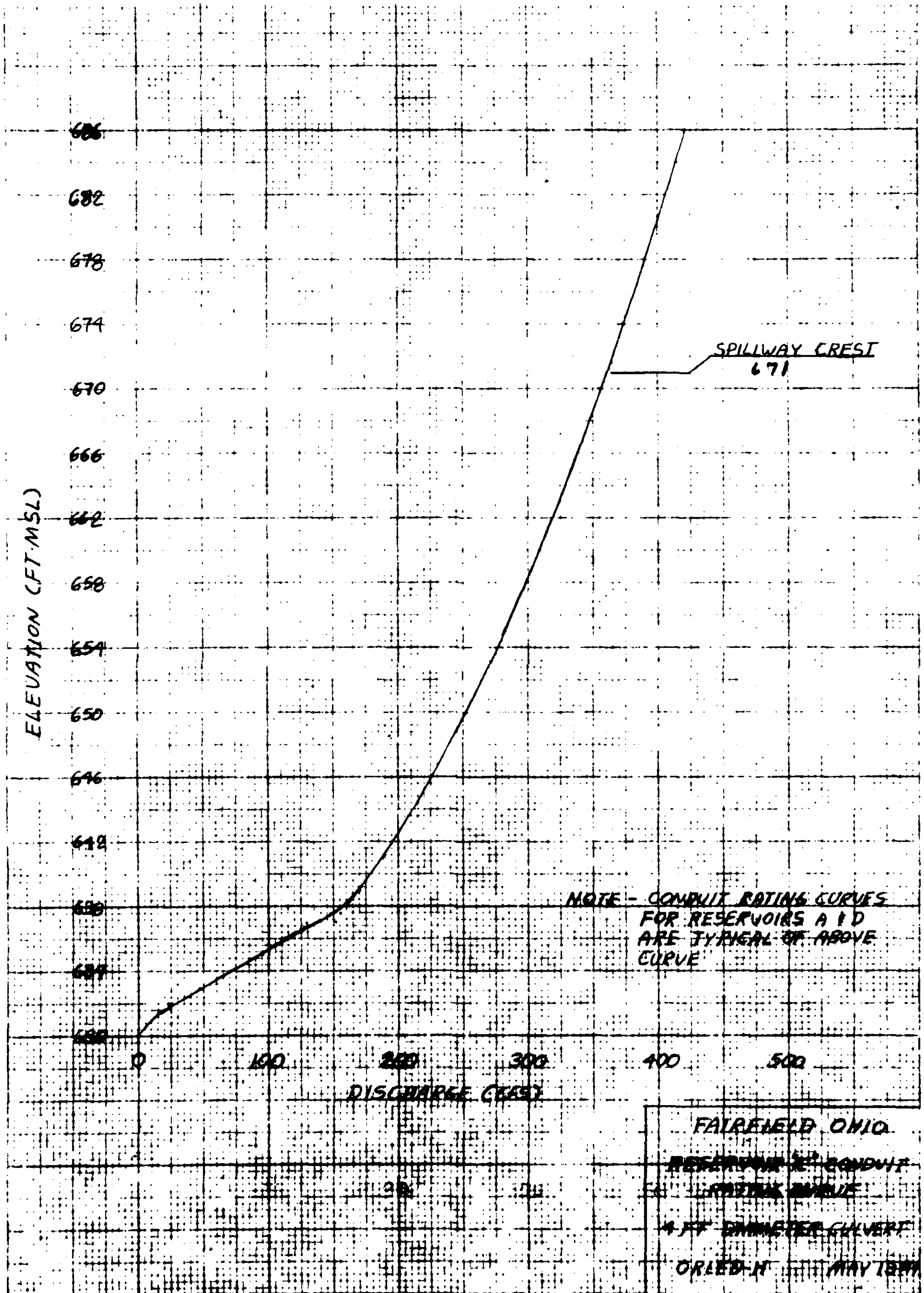
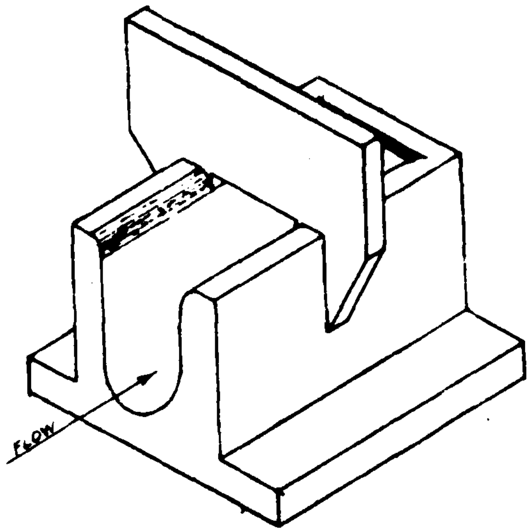
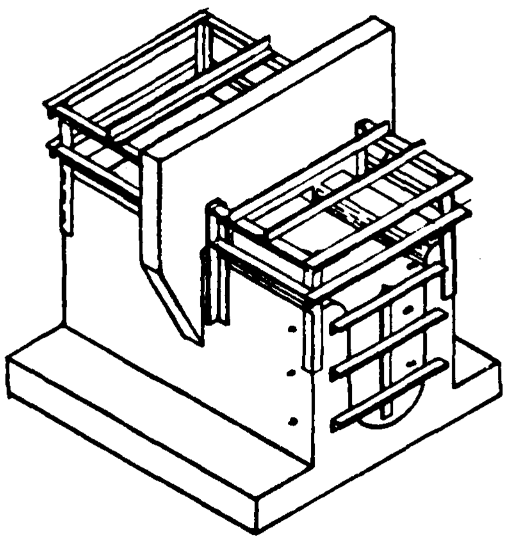

ELEVATION (FT MSL)
DISCHARGE (CFS)
0
100
200
300
400
500
674
670
666
658
650
SPILLWAY CREST
671
NOTE - CONDUIT RATING CURVES FOR RESERVOIRS A & D ARE TYPICAL OF ABOVE CURVE
FAIRFIELD OHIO
4 FT DIAMETER CULVERT
ORLED-H
MAY

PLATE D-67

RPS OF ENGINEERS, U.S. ARMY OHIO RIVER DIVISION	COMPUTATION SHEET	PAGE 3 OF 4 PAGES
		DATE February 1981
TALLATION	SUBJECT Fairfield, Ohio - Local Flood Protection Project	NUMBER
MPUTED BY MH	COMPUTATION Proposed Principal Spillway Inlet	
CKED BY		

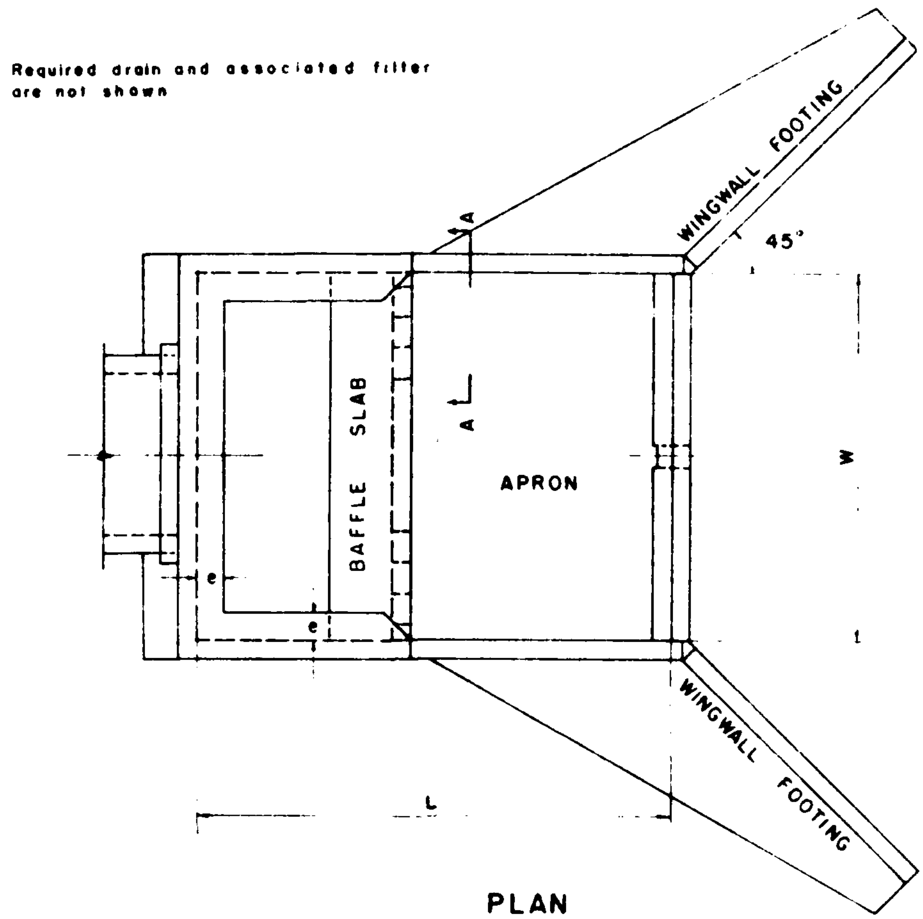


ISOMETRIC

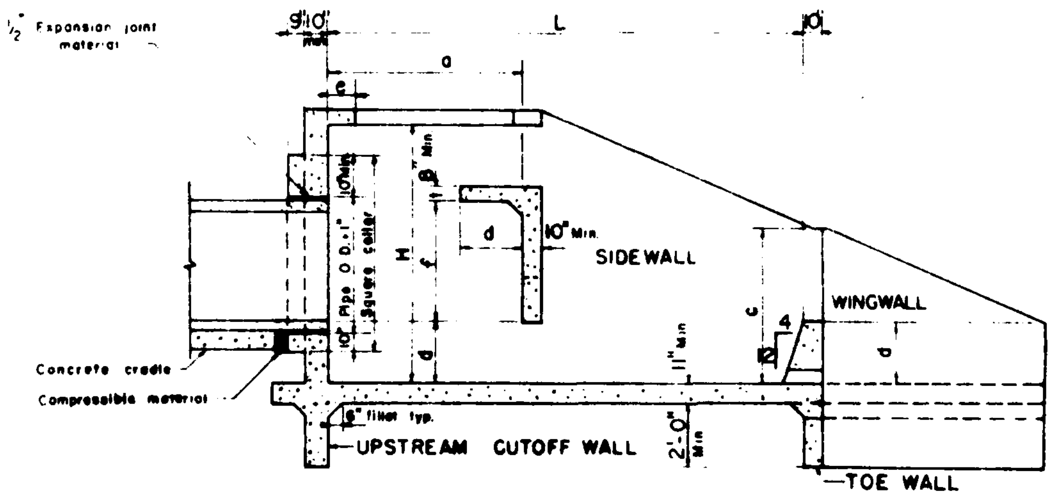


ISOMETRIC VIEW

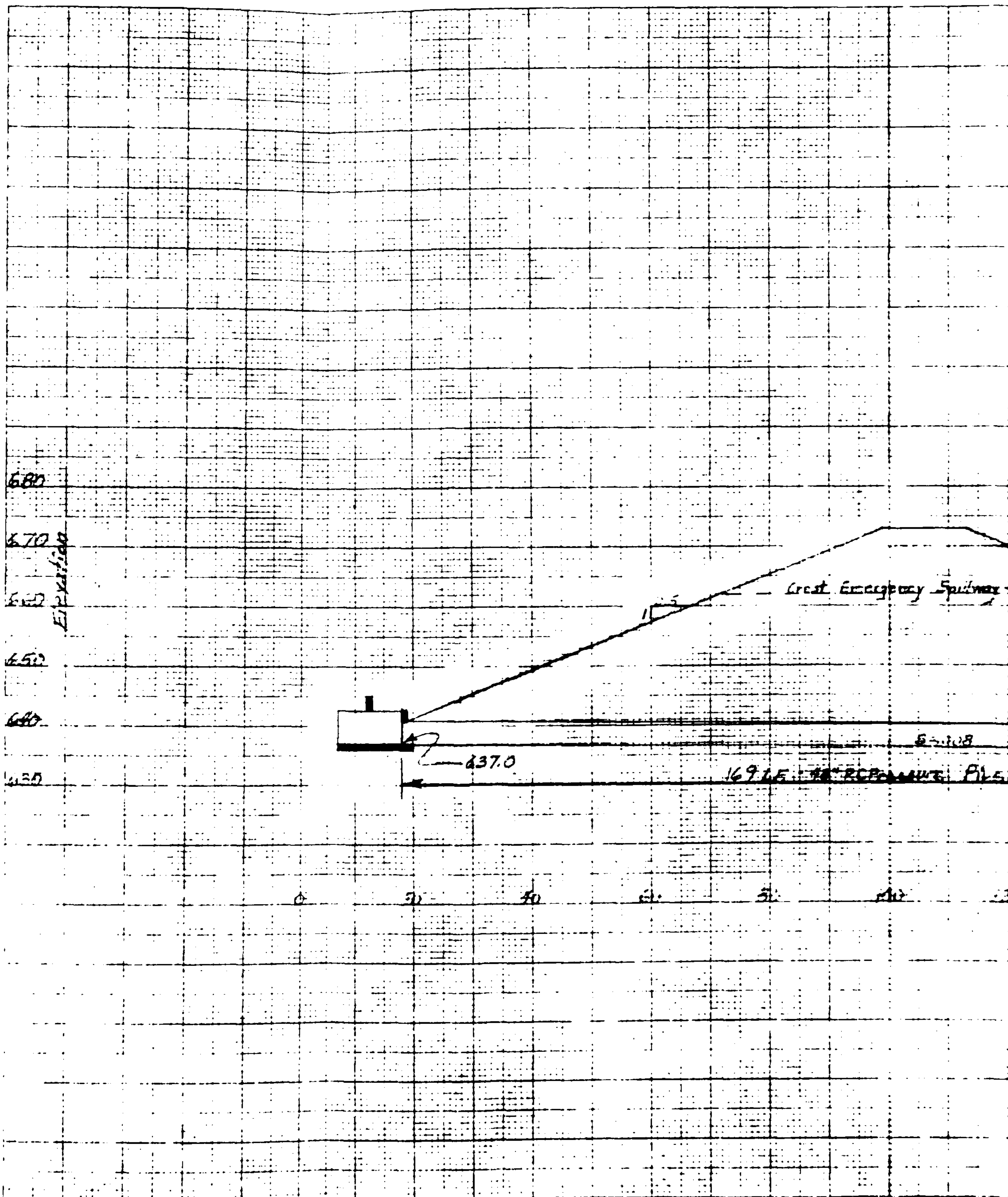
IMPACT BASINS: General Layout and Hydraulic Design

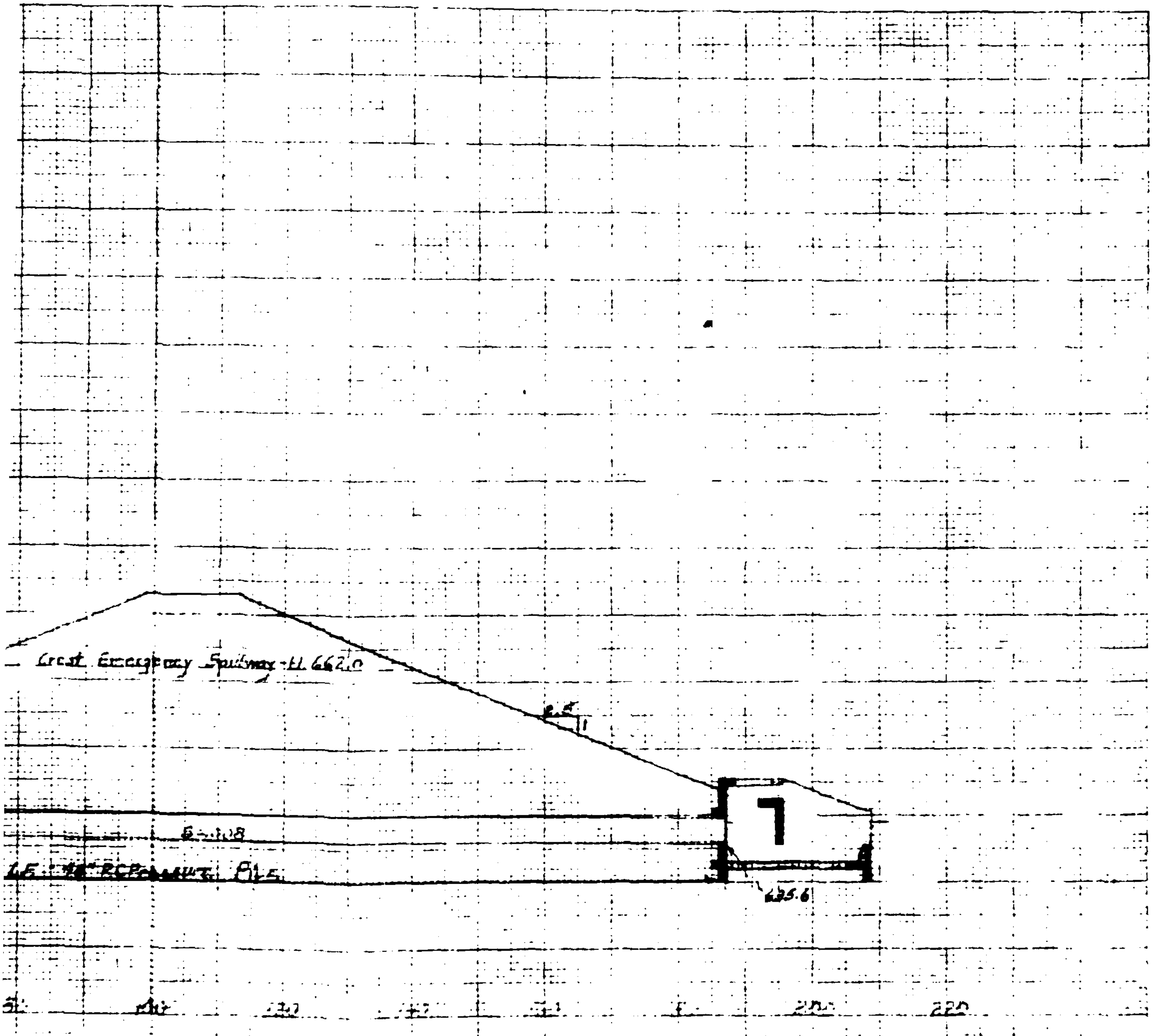


PLAN



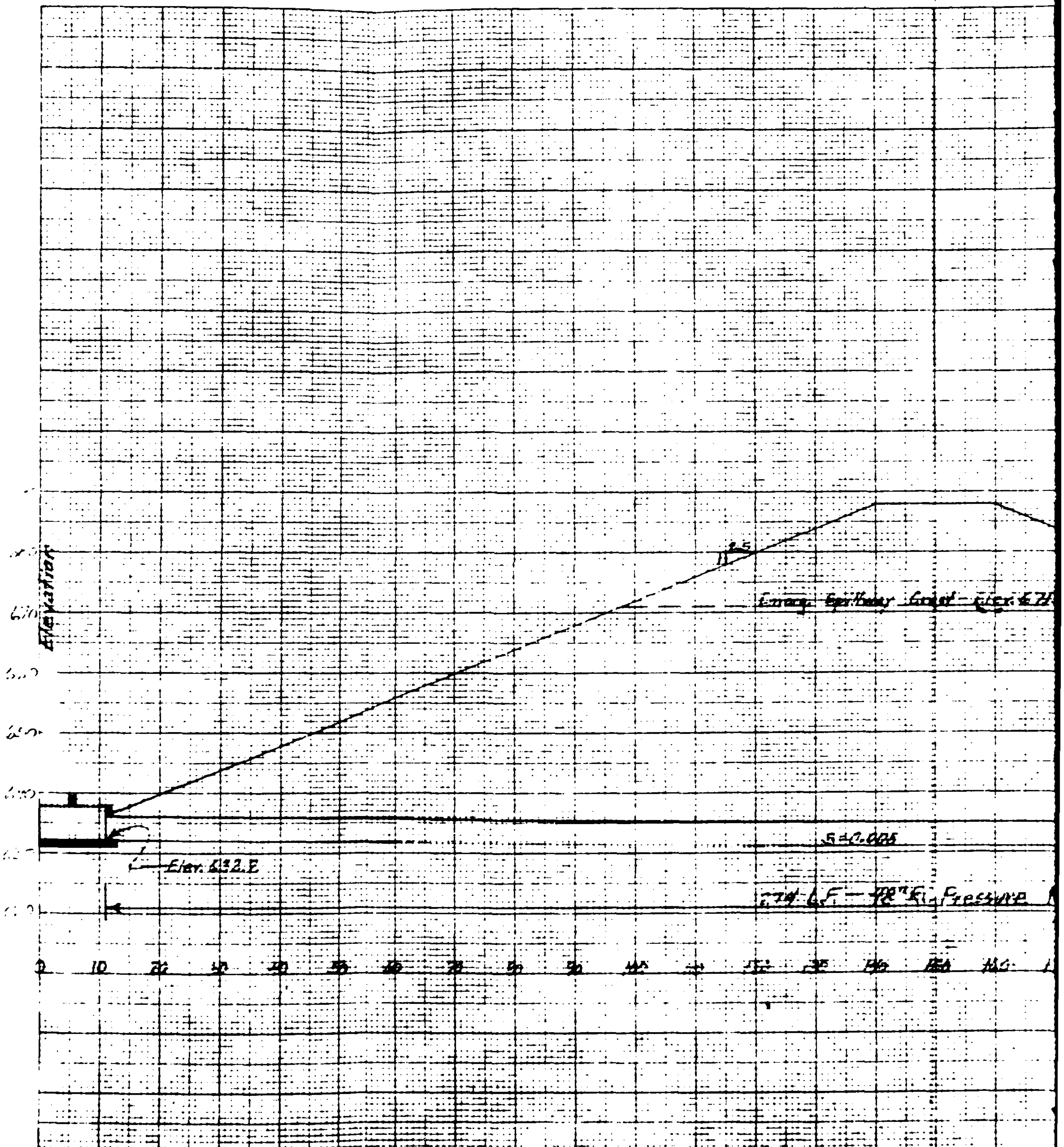
SECTION ON CENTER LINE


680
670
Elevation
650
Crest Emergency Spillway
637.0
169 LF

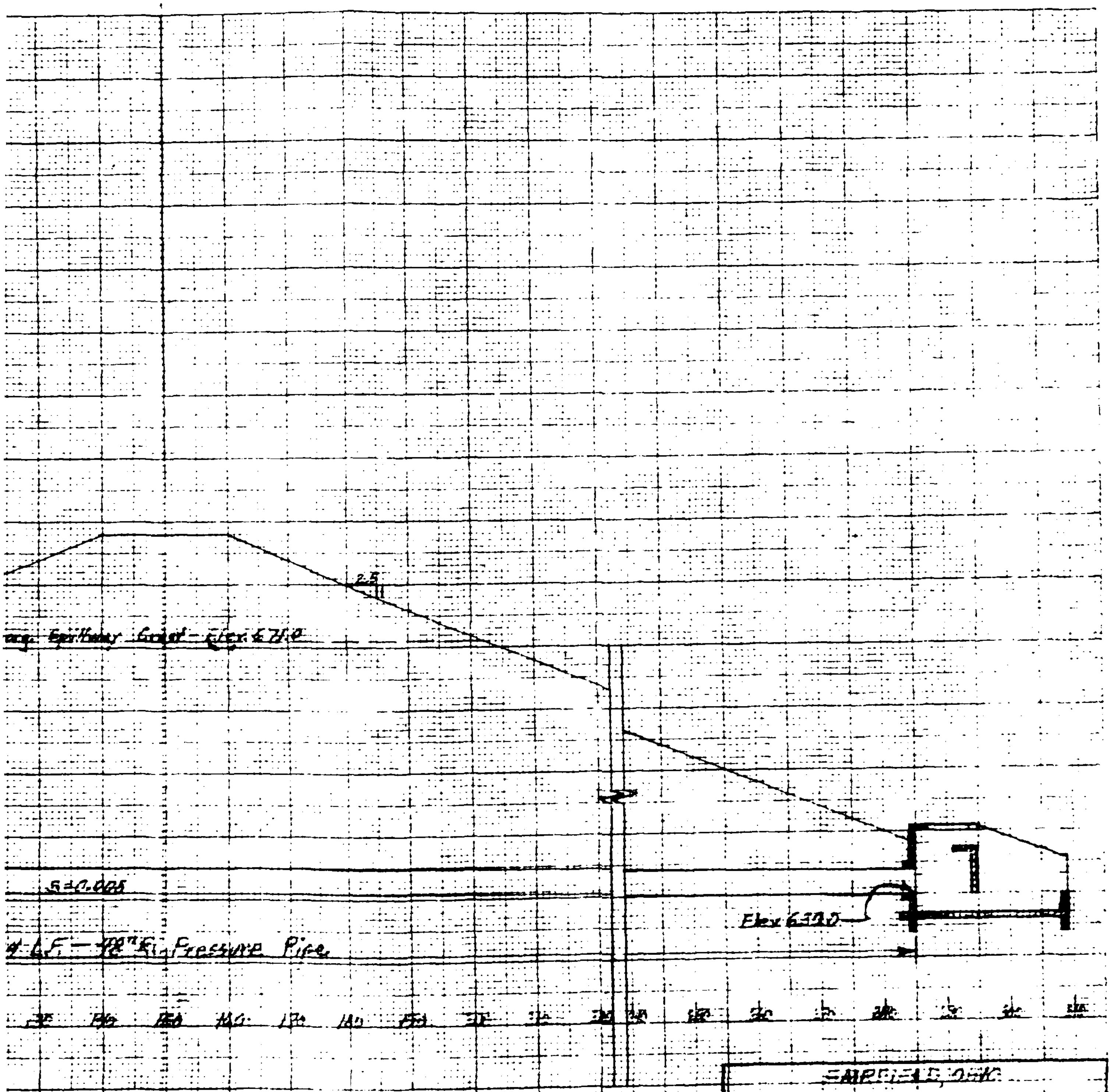


FAIRFIELD, OHIO
Local Flood Protection Project
High School Branch
- Reservoir A -
Dam Site Profile
Louisville, Ky. ORLED-H Feb. 195[illegible]

PLATE D-70



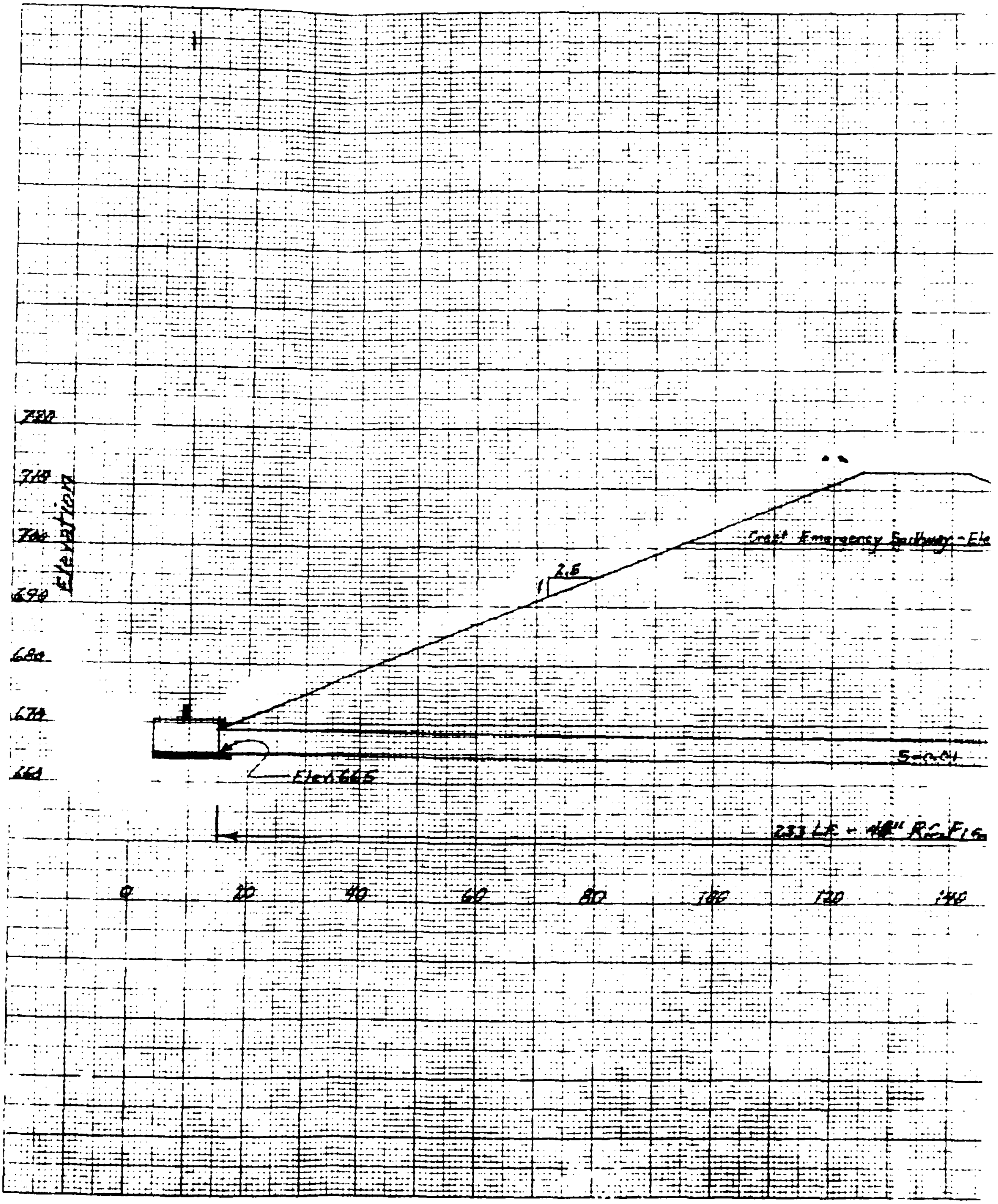
Elevation
2.5
1
Elev. 632.8
S = 0.005
0
10

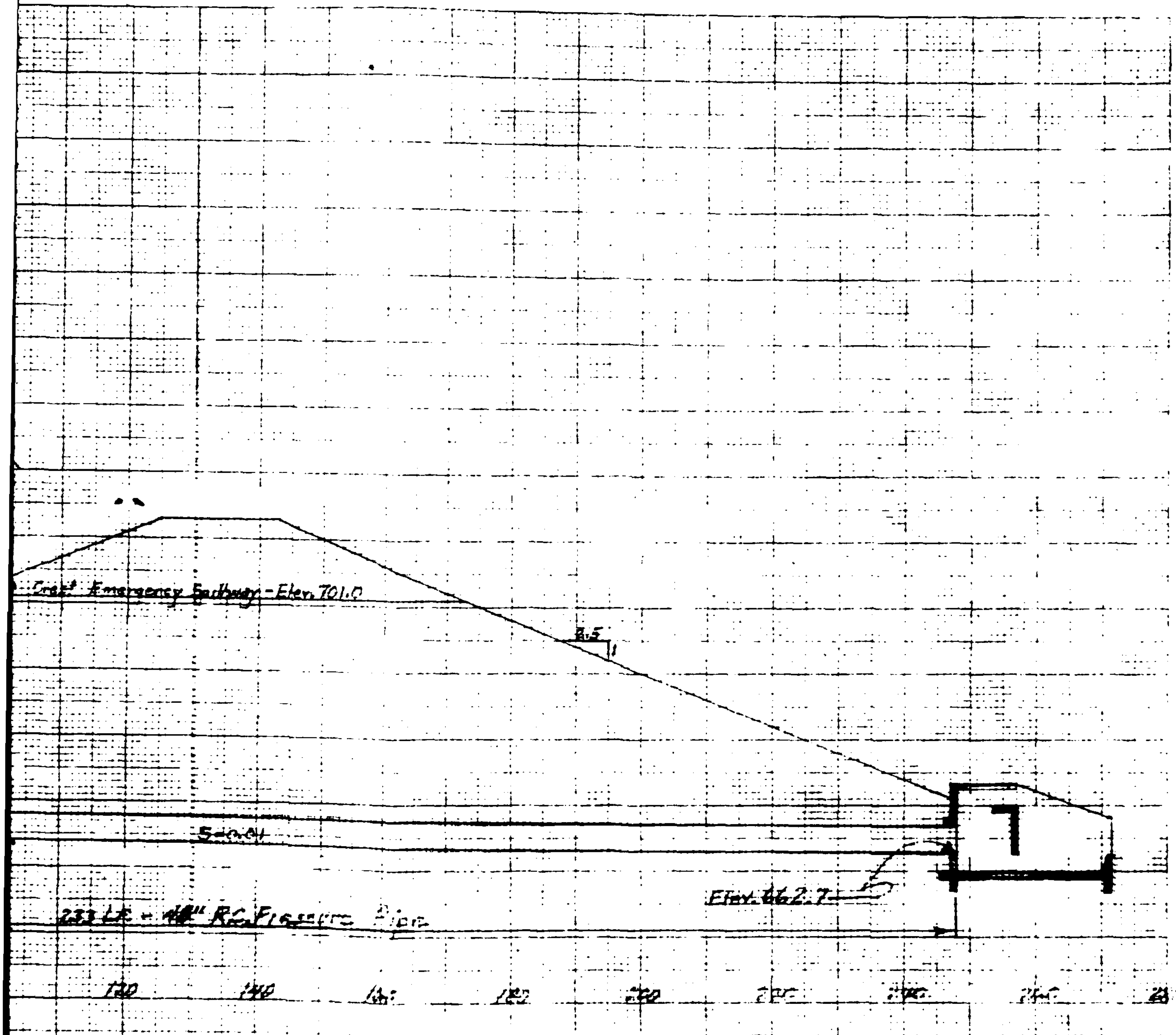


Dam Site Profile

Feb. 1981

PLATE D-71


720
710
700
690
680
670
660
Elevation
2.6
1
Crest Emergency Spillway - Ele
Elev 666
0
20
40
60
80
100
120
140



FAIRFIELD, OHIO

Local Flood Protection Project

Pleasant Run

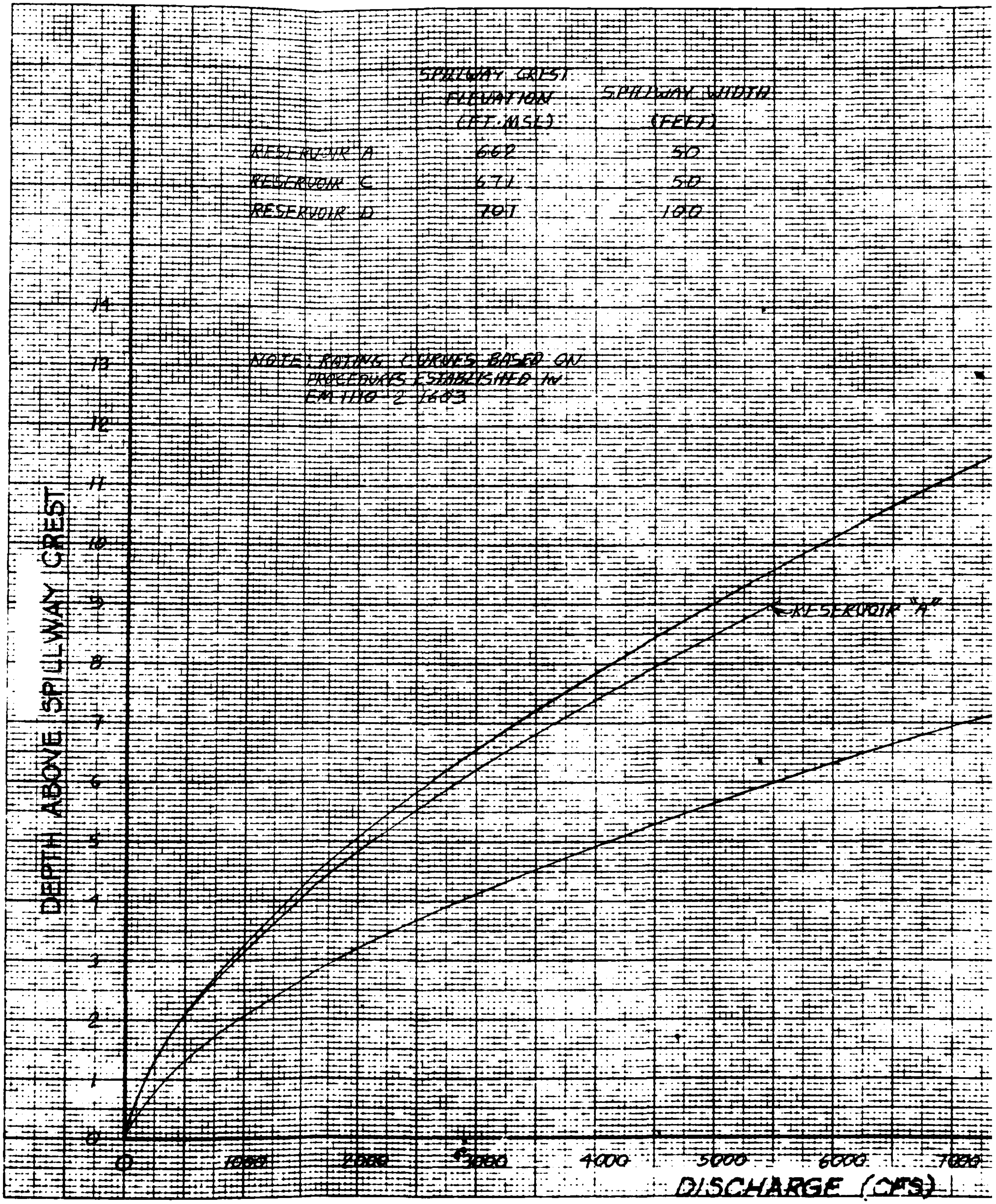
Reservoir D

Dam Site Profile

Louisville, Ky. March, 1961

ORLED-H

PLATE D-72


SPILLWAY CREST ELEVATION (FT. MSL)
SPILLWAY WIDTH (FEET)
RESERVOIR A 662 50
RESERVOIR C 671 50
RESERVOIR D 707 100
NOTE: RATING CURVES BASED ON PROCEDURES ESTABLISHED IN EM 1110 2 1603
RESERVOIR "A"
DEPTH ABOVE SPILLWAY CREST
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14
DISCHARGE (CFS)
0 1000 2000 3000 4000 5000 6000 7000

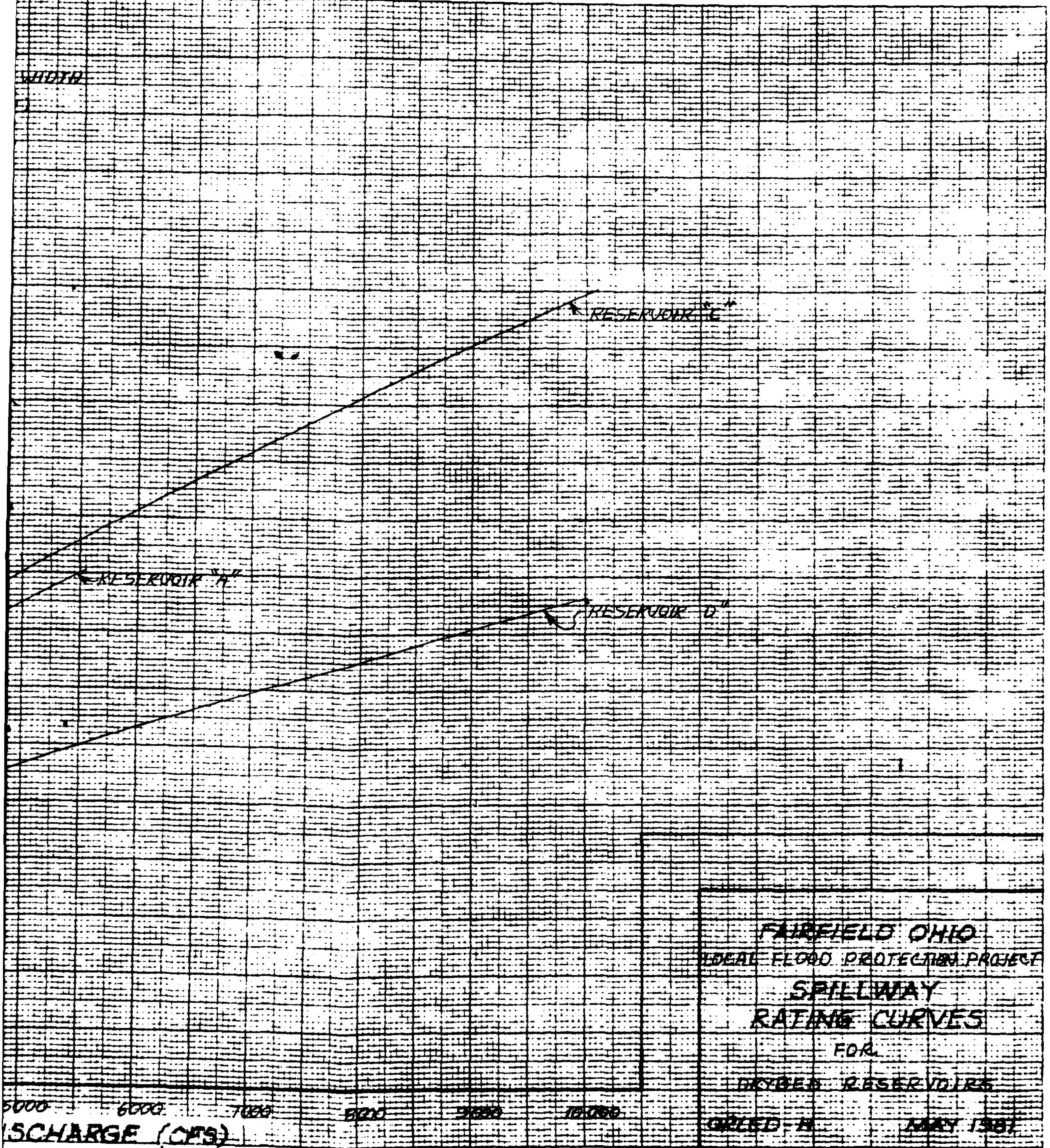
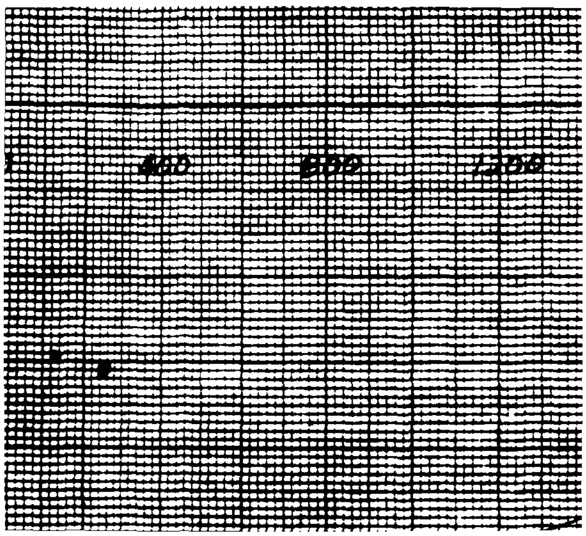
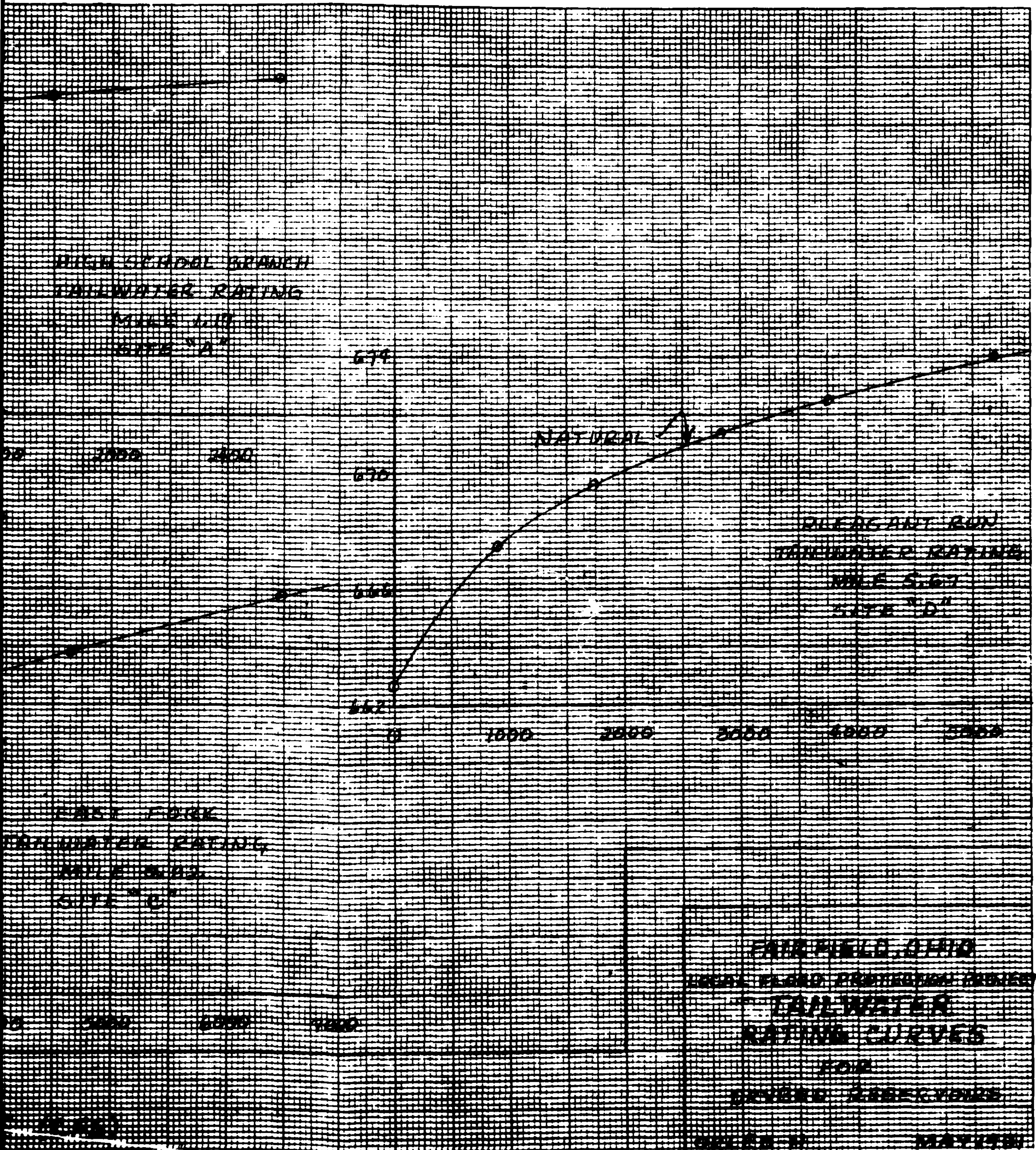

WIDTH
RESERVOIR "C"
RESERVOIR "A"
RESERVOIR "D"
5000
6000
7000
8000
9000
10,000
SCHARGE (CFS)
FAIRFIELD OHIO
LOCAL FLOOD PROTECTION PROJECT
SPILLWAY
RATING CURVES
FOR
DRYBED RESERVOIRS
ORLED-H
MAY 1981

PLATE D-73

2

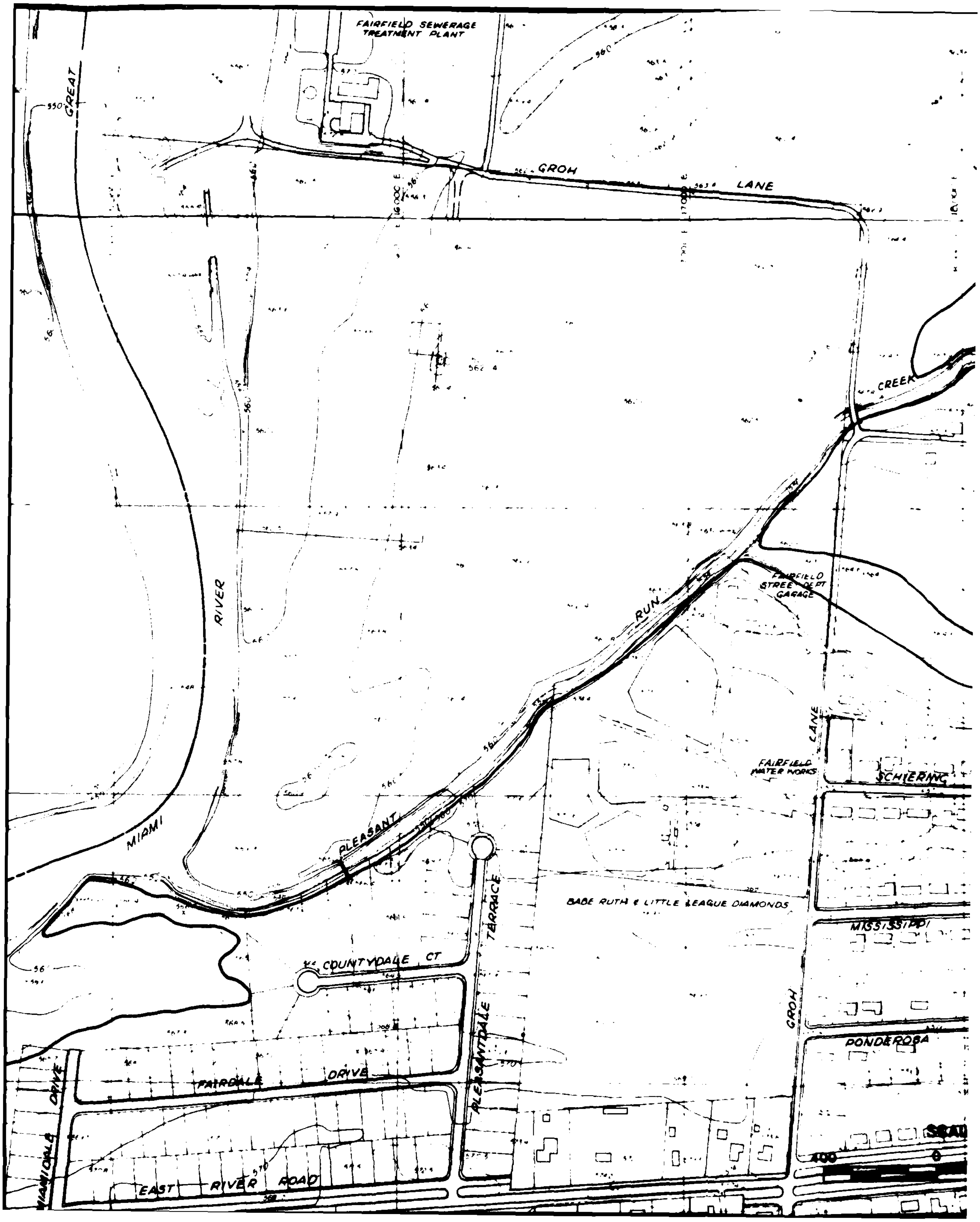

400
800
1200



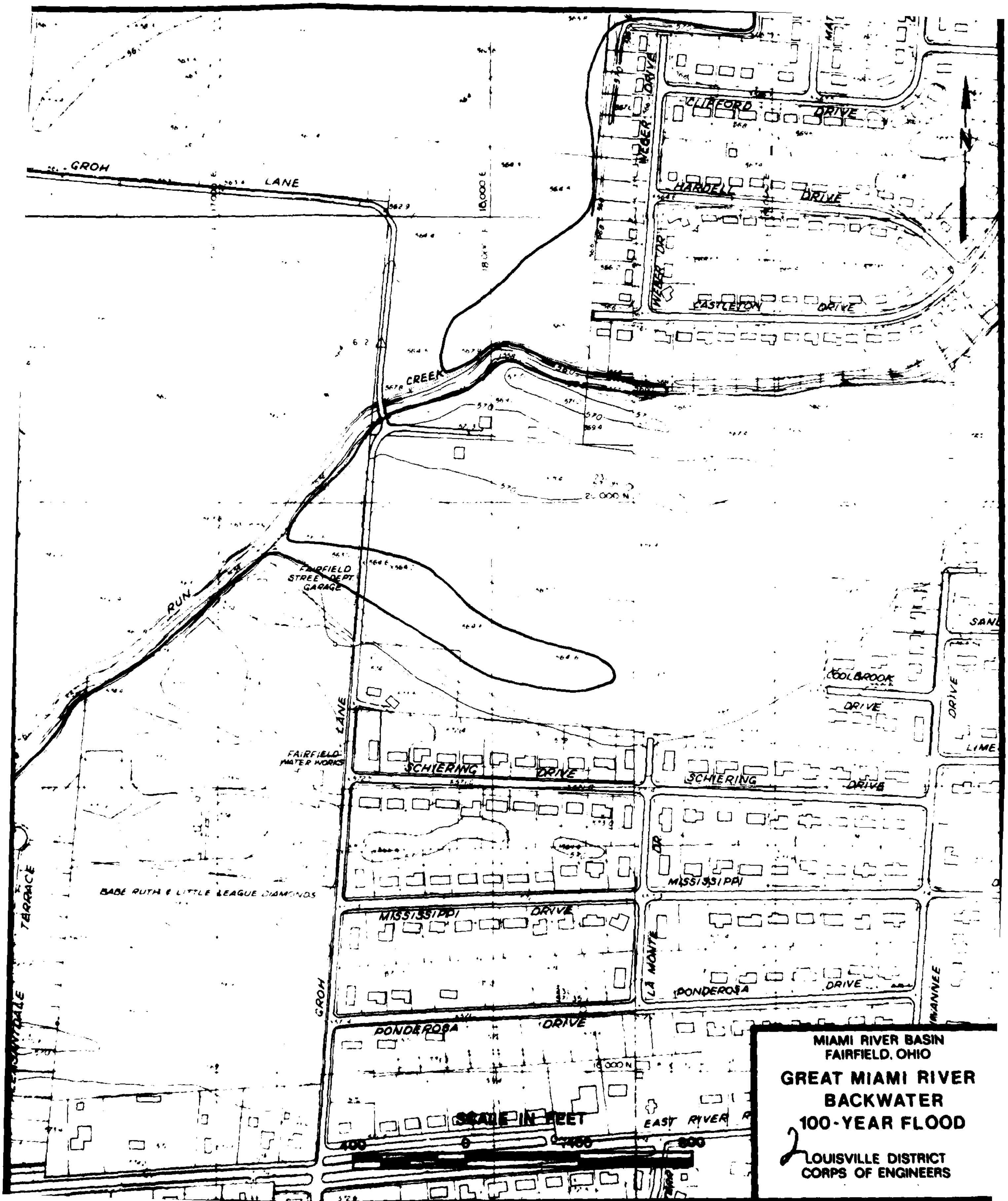
HIGH SCHOOL BRANCH
TAILWATER RATING
SITE "A"
2000
2400
674
670
666
662
NATURAL
TAILWATER RATING
SITE "D"
0
1000
2000
3000
4000
5000
EAST FORK
TAILWATER RATING
SITE "C"
FAIRFIELD, OHIO
TAILWATER
RATING CURVES
FOR

PLATE D-74

2



FAIRFIELD SEWERAGE TREATMENT PLANT
GROH LANE
GREAT MIAMI RIVER
CREEK
PLEASANT RUN
FAIRFIELD STREET DEPT GARAGE
FAIRFIELD WATER WORKS
SCHIERING
BABE RUTH & LITTLE LEAGUE DIAMONDS
MISSISSIPPI
PONDEROSA
GROH LANE
COUNTYDALE CT
PLEASANTDALE TERRACE
FAIRDALE DRIVE
MIAMIDALE DRIVE
EAST RIVER ROAD



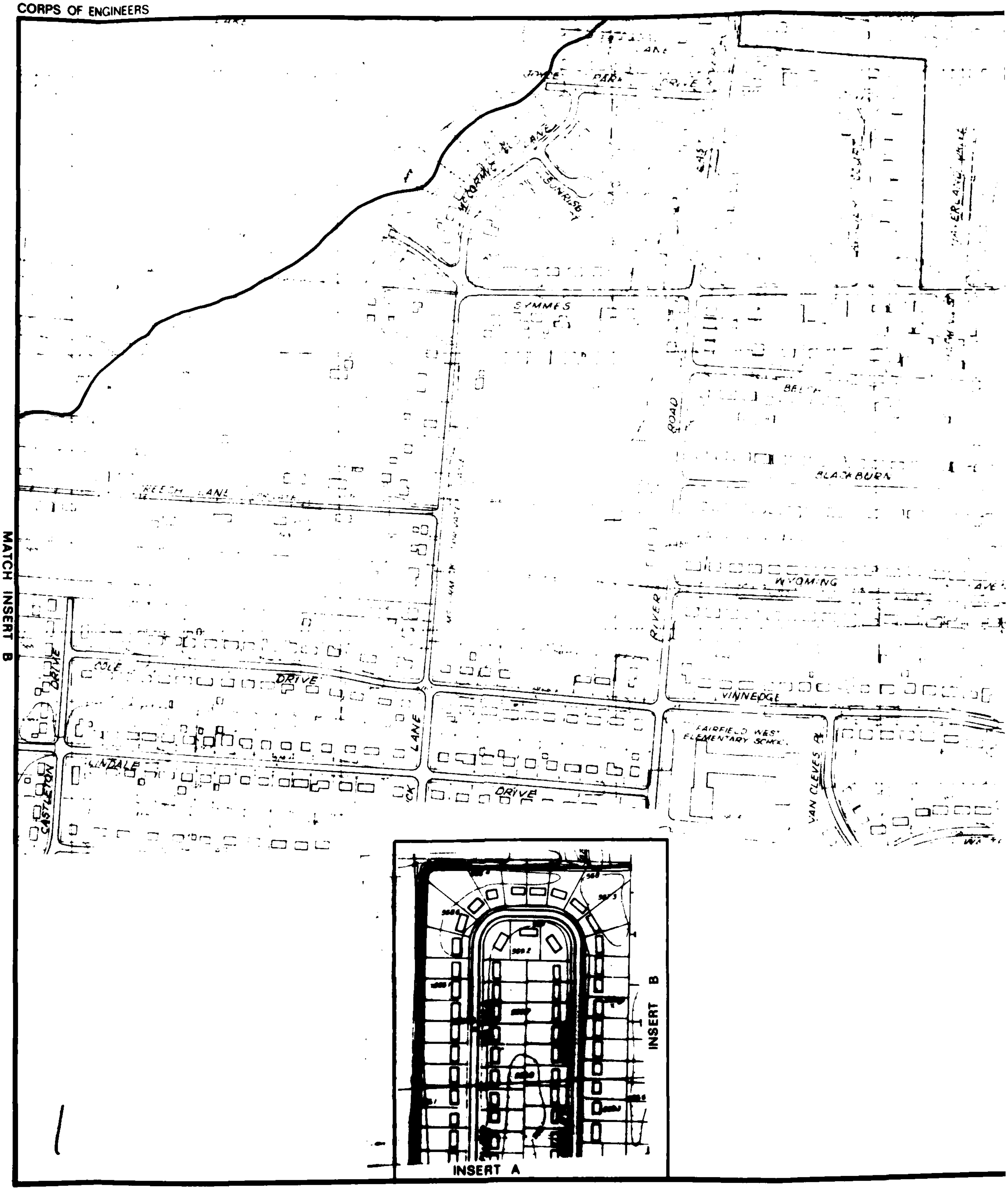
MIAMI RIVER BASIN
FAIRFIELD, OHIO

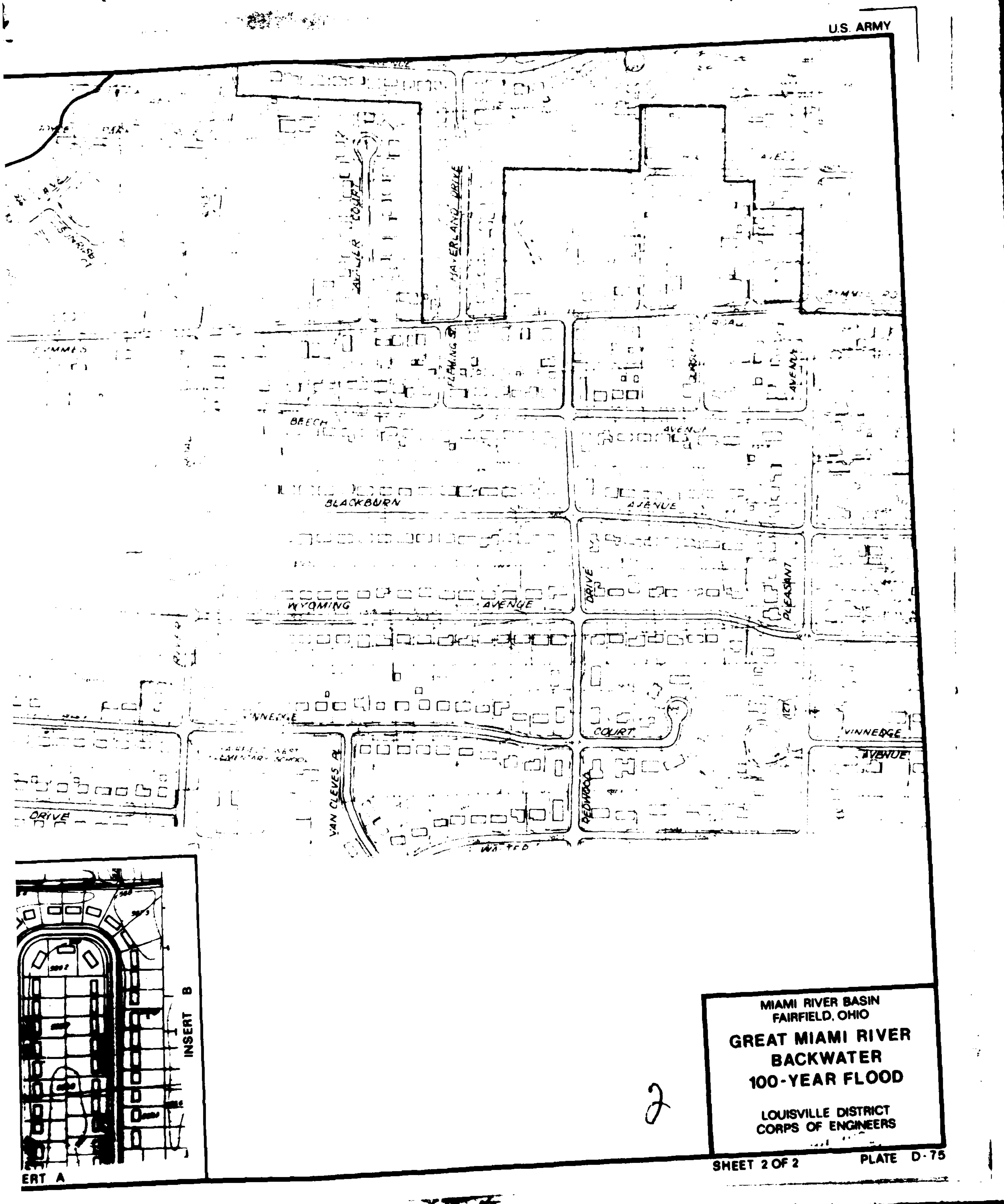
GREAT MIAMI RIVER
BACKWATER
100-YEAR FLOOD

LOUISVILLE DISTRICT
CORPS OF ENGINEERS

SHEET 1 OF 2 PLATE D-

CORPS OF ENGINEERS





MIAMI RIVER BASIN
FAIRFIELD, OHIO

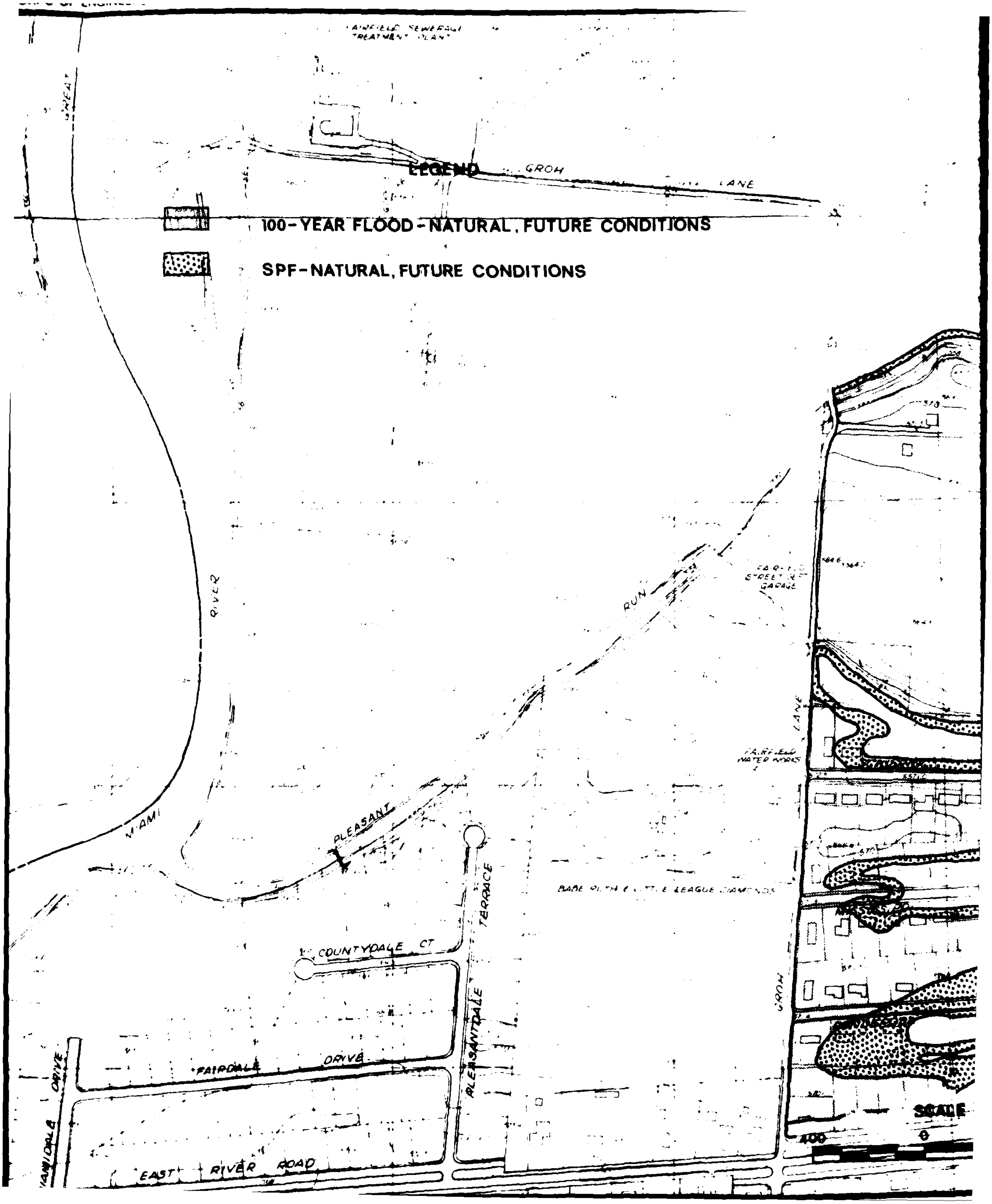
GREAT MIAMI RIVER
BACKWATER
100-YEAR FLOOD

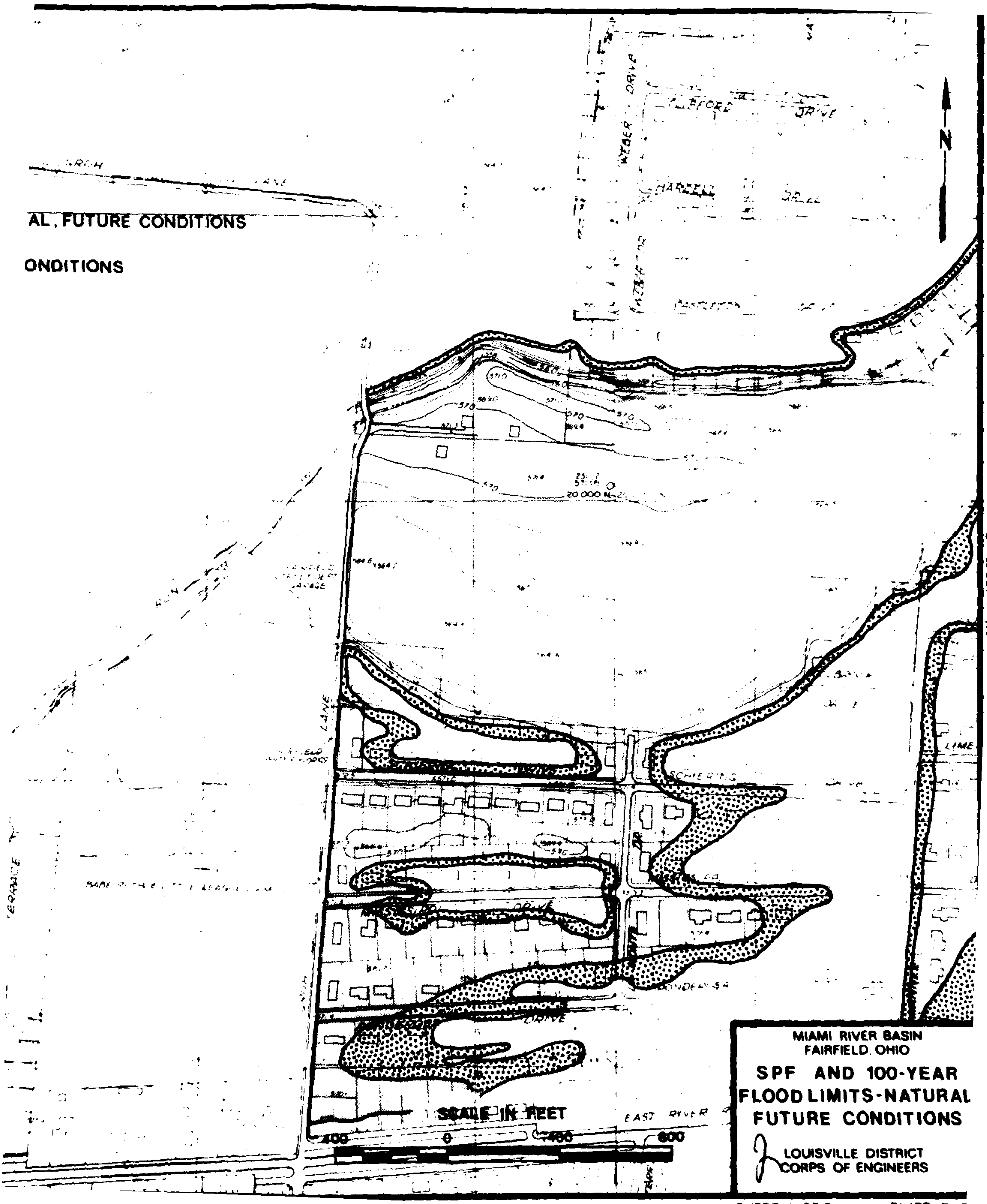
LOUISVILLE DISTRICT
CORPS OF ENGINEERS

2

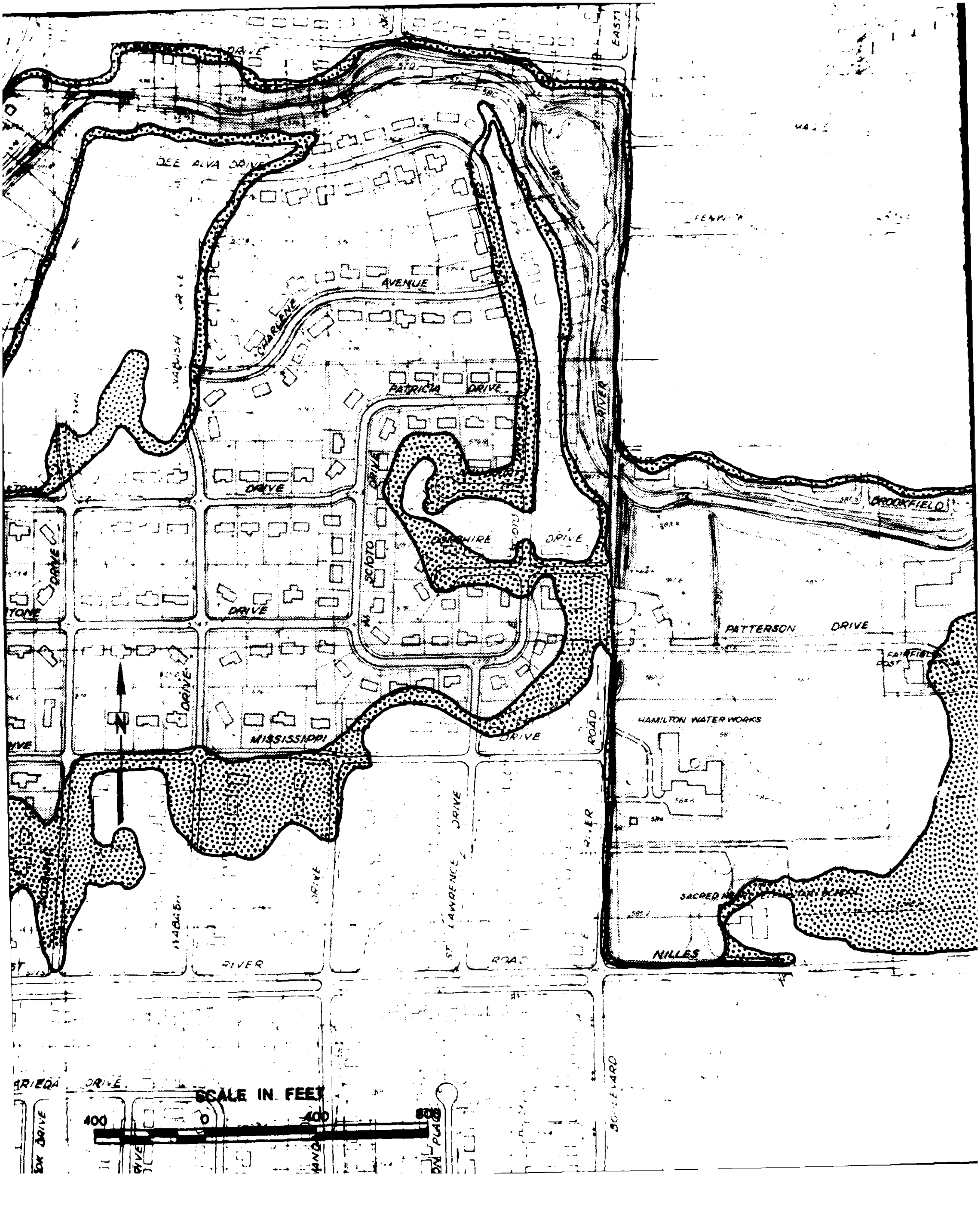
SHEET 2 OF 2

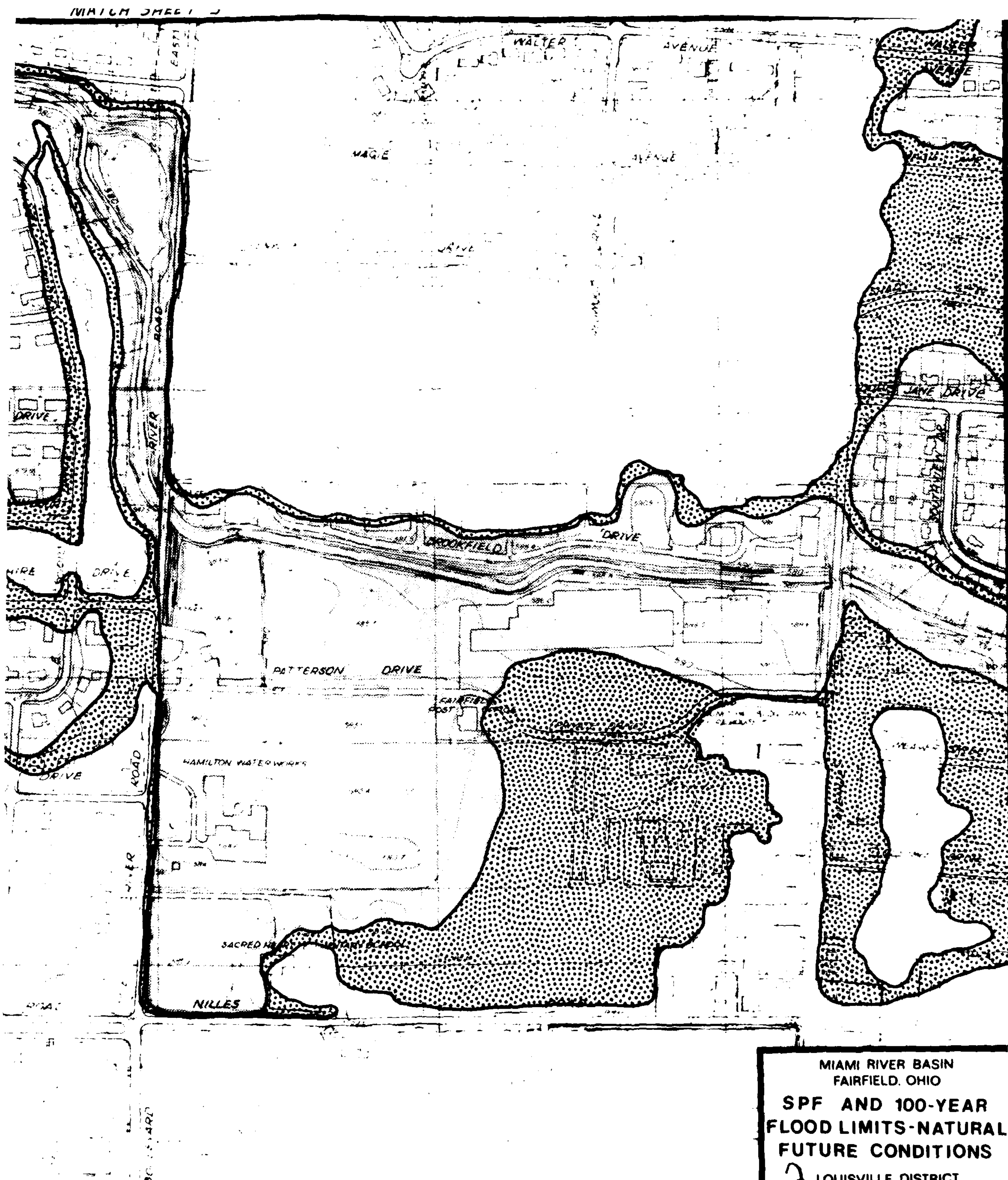
PLATE D-75


FAIRFIELD SEWERAGE TREATMENT PLANT
GROH LANE
LEGEND
100-YEAR FLOOD-NATURAL, FUTURE CONDITIONS
SPF-NATURAL, FUTURE CONDITIONS
GREAT MIAMI RIVER
RUN
FAIRFIELD STREET DEPT GARAGE
FAIRFIELD WATER WORKS
PLEASANT
BABE RUTH & LITTLE LEAGUE DIAMONDS
TERRACE
COUNTYDALE CT
PLEASANTDALE
FAIRDALE DRIVE
DRIVE
EAST RIVER ROAD
GROH LANE
SCALE
400 0



SHEET 1 OF 9 PLATE D-7


DEE ALVA DRIVE
CHARLENE
AVENUE
PATRICIA DRIVE
DRIVE
DORSHIRE
DRIVE
SCIOTO
DRIVE
MISSISSIPPI
DRIVE
ROAD
RIVER
ROAD
BROOKFIELD
PATTERSON DRIVE
HAMILTON WATER WORKS
SACRED
NILLES
RIVER
ROAD
ST. LAWRENCE
DRIVE
WABASH
DRIVE
BOULEVARD
SCALE IN FEET
400
0
400
800
N

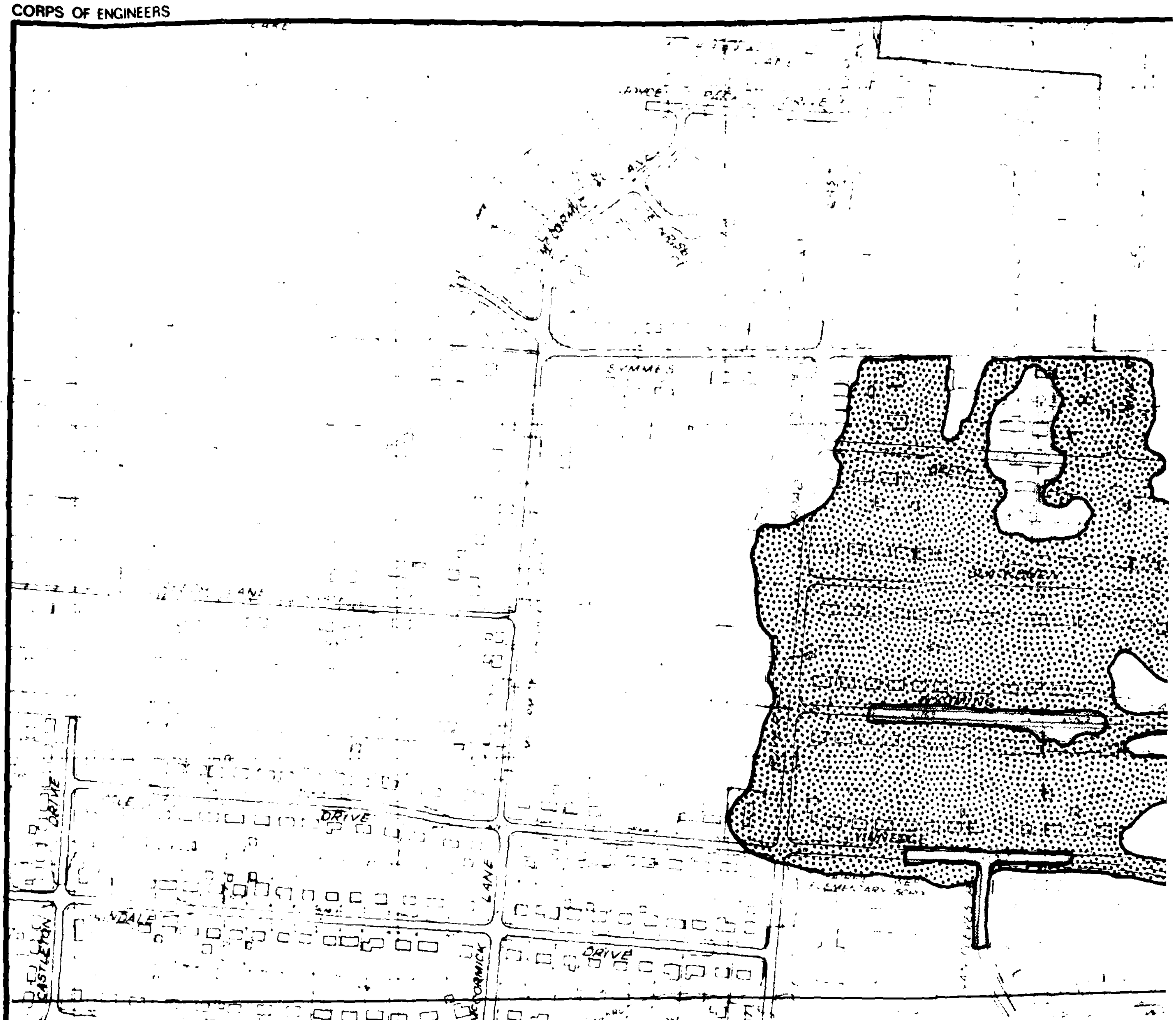


MIAMI RIVER BASIN
FAIRFIELD, OHIO

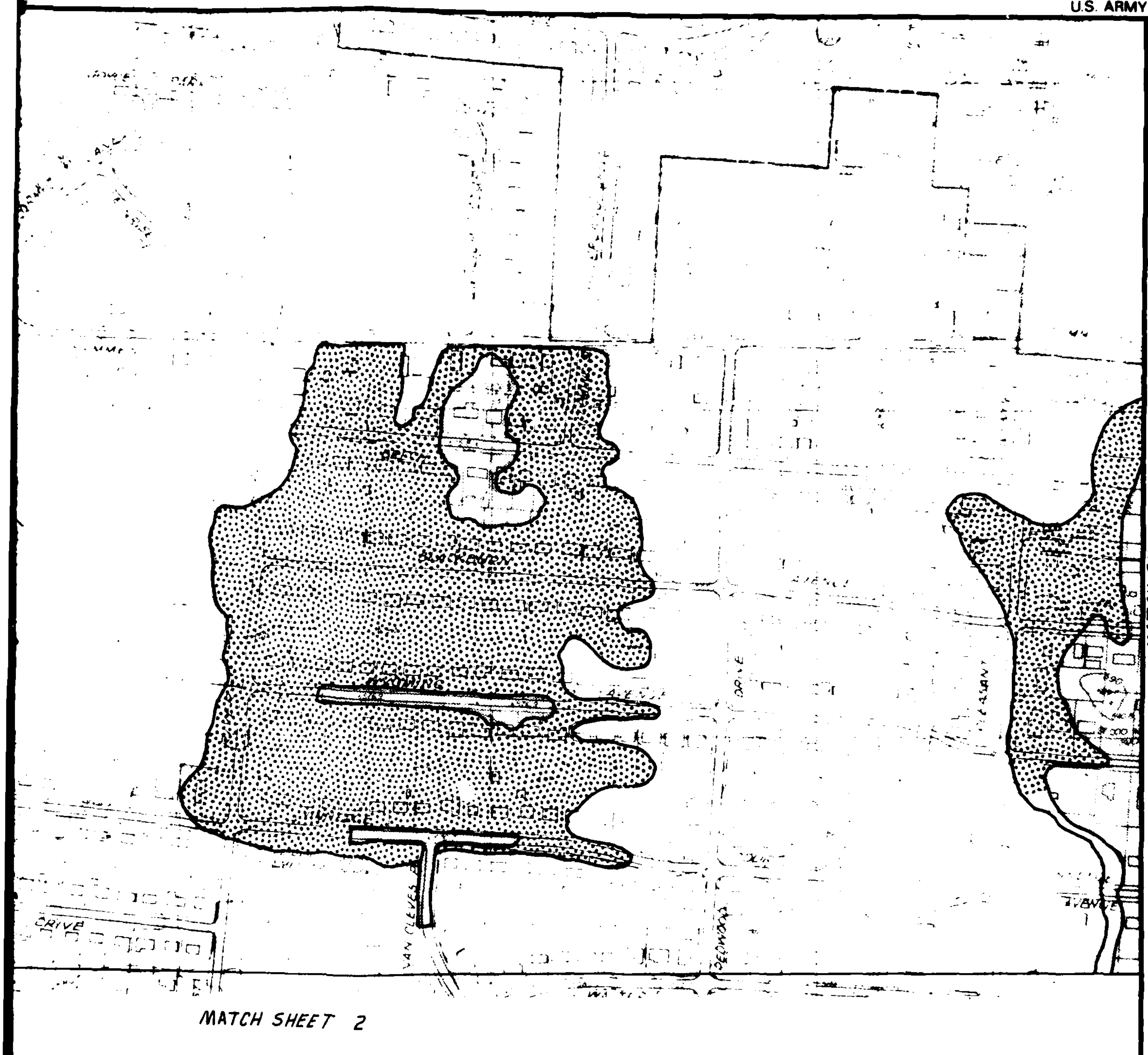
SPF AND 100-YEAR FLOOD LIMITS-NATURAL FUTURE CONDITIONS

LOUISVILLE DISTRICT
CORPS OF ENGINEERS

CORPS OF ENGINEERS



MATCH SHEET 2



2

MIAMI RIVER BASIN
FAIRFIELD, OHIO

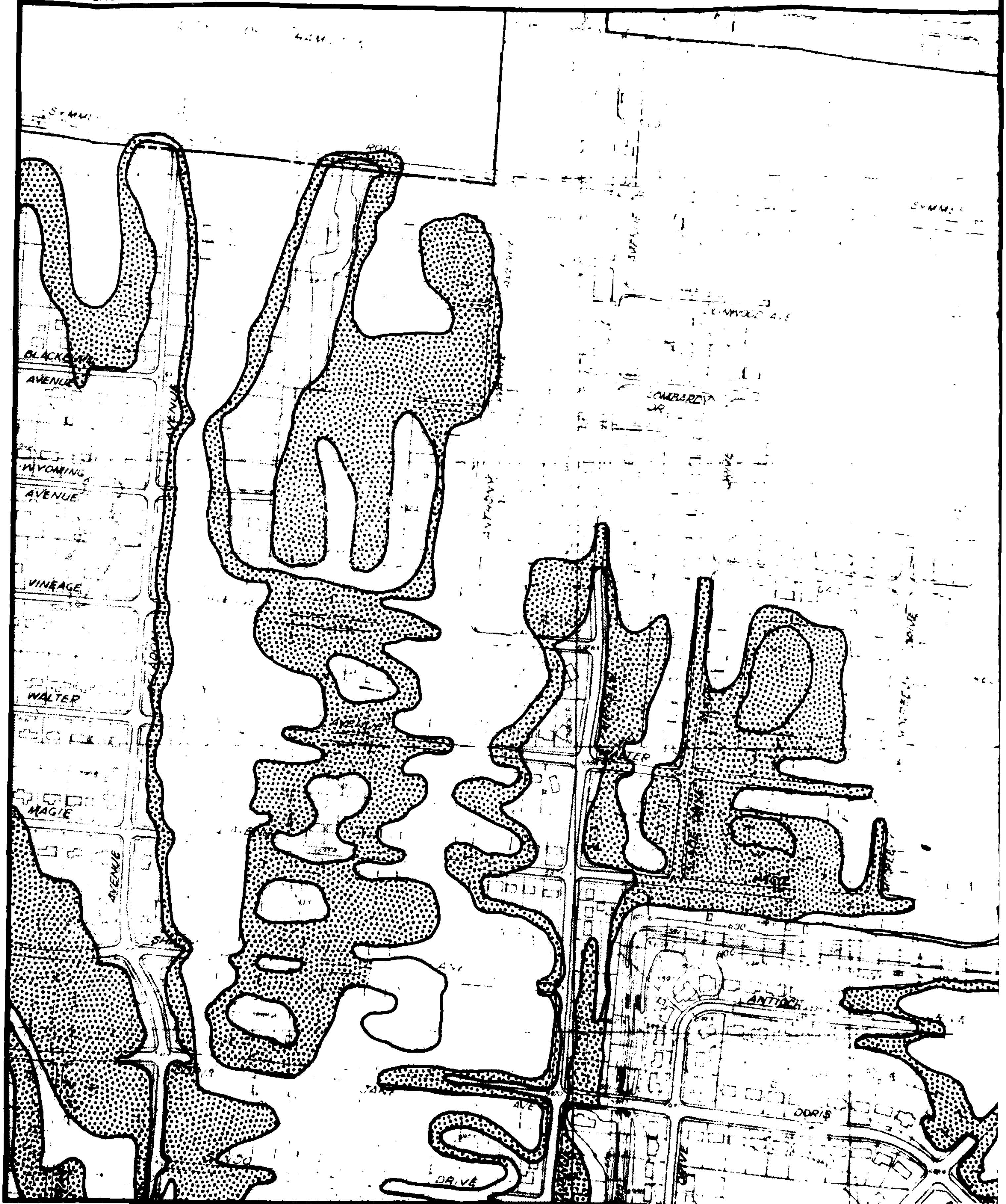
SPF AND 100-YEAR FLOOD LIMITS-NATURAL FUTURE CONDITIONS

LOUISVILLE DISTRICT
CORPS OF ENGINEERS

SHEET 3 OF 9 PLATE D-76

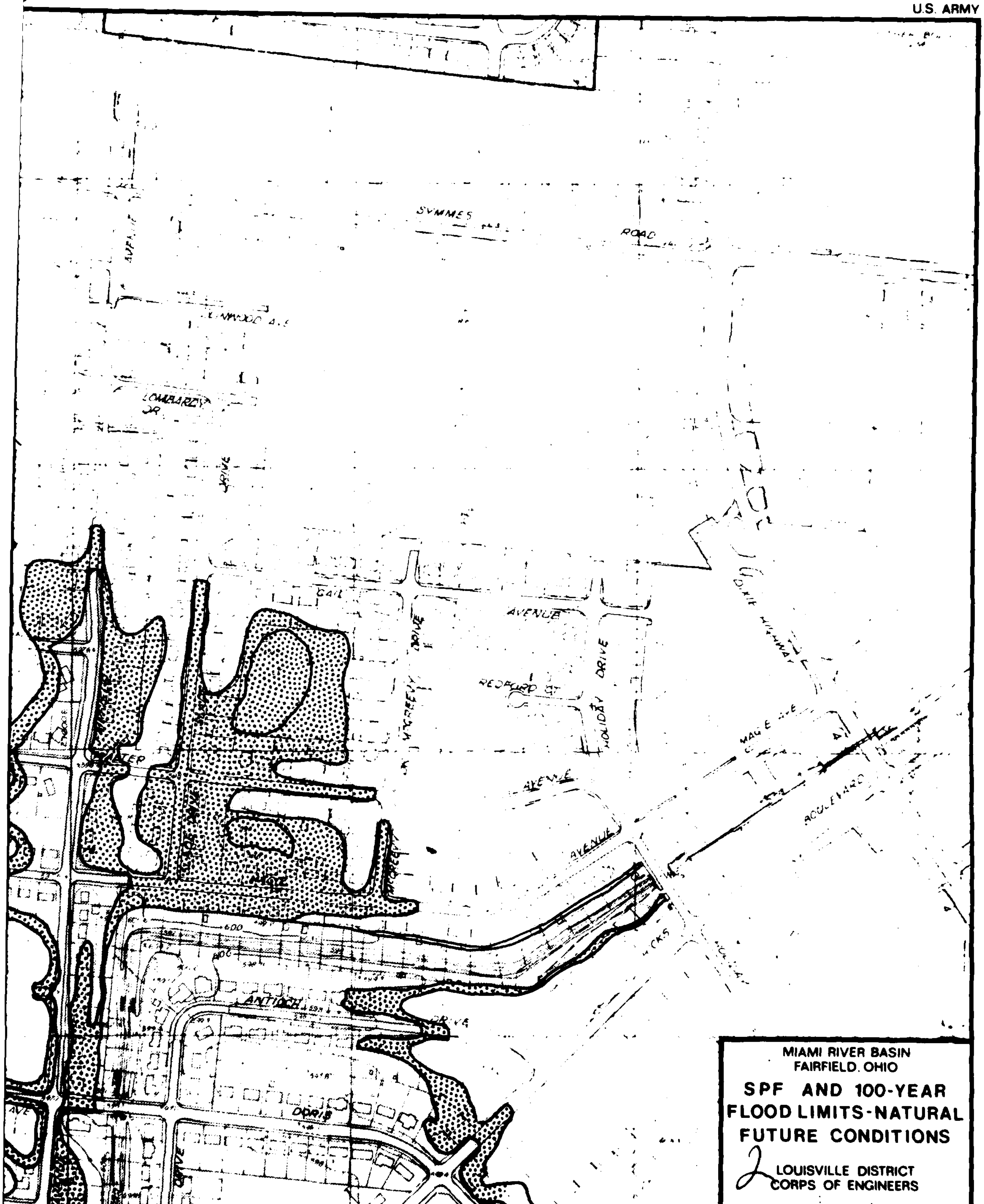
CORPS OF ENGINEERS

MATCH SHEET 3



MATCH SHEET 5

U.S. ARMY



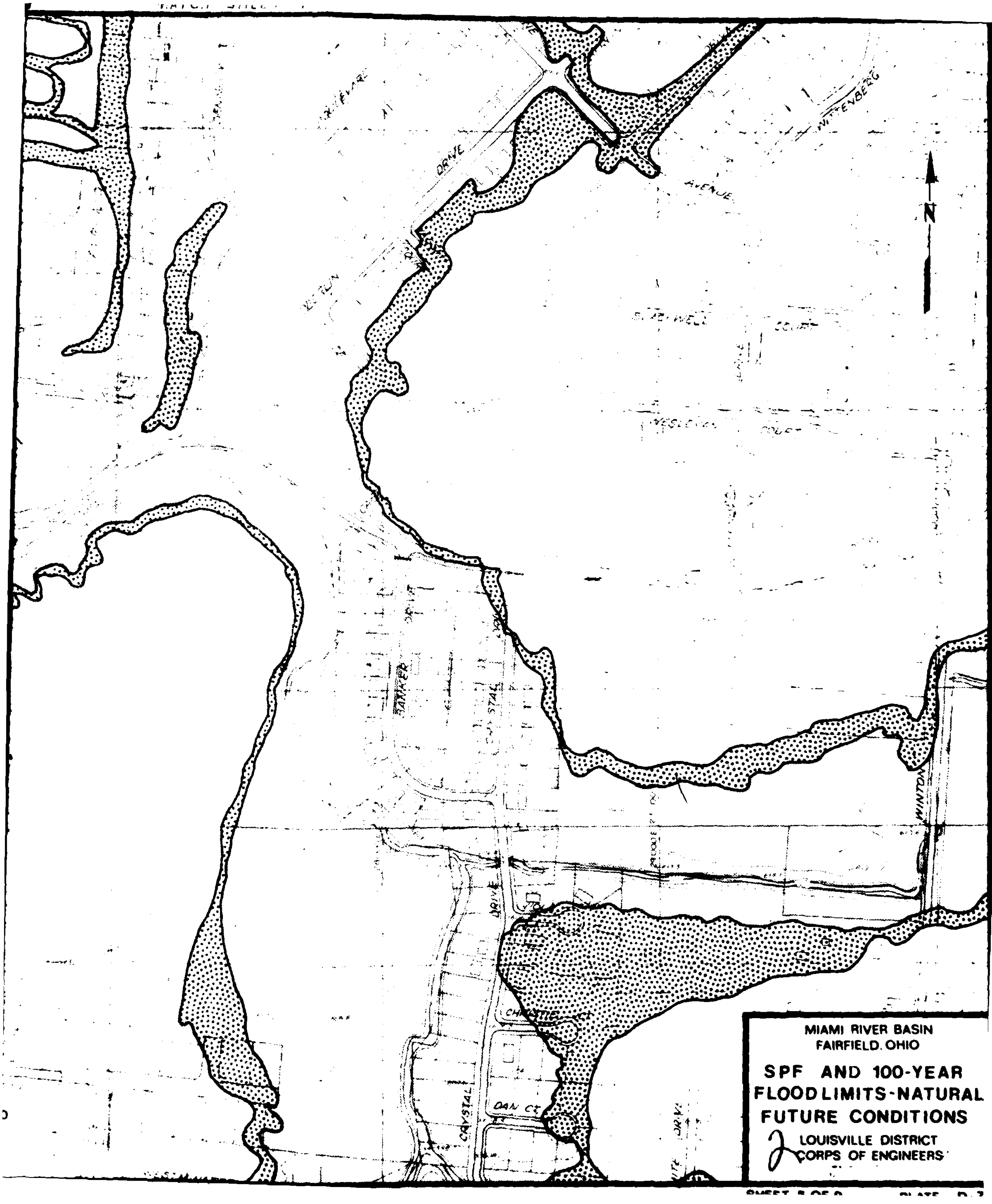
MIAMI RIVER BASIN
FAIRFIELD, OHIO

SPF AND 100-YEAR FLOOD LIMITS-NATURAL FUTURE CONDITIONS

LOUISVILLE DISTRICT
CORPS OF ENGINEERS

MATCH SHEET 5


SOUTHVIEW
AVENUE
SOUTHVIEW DR
DENNISON
ROAD
TANNER
CRYSTAL
SCALE IN FEET
400
0
400
800

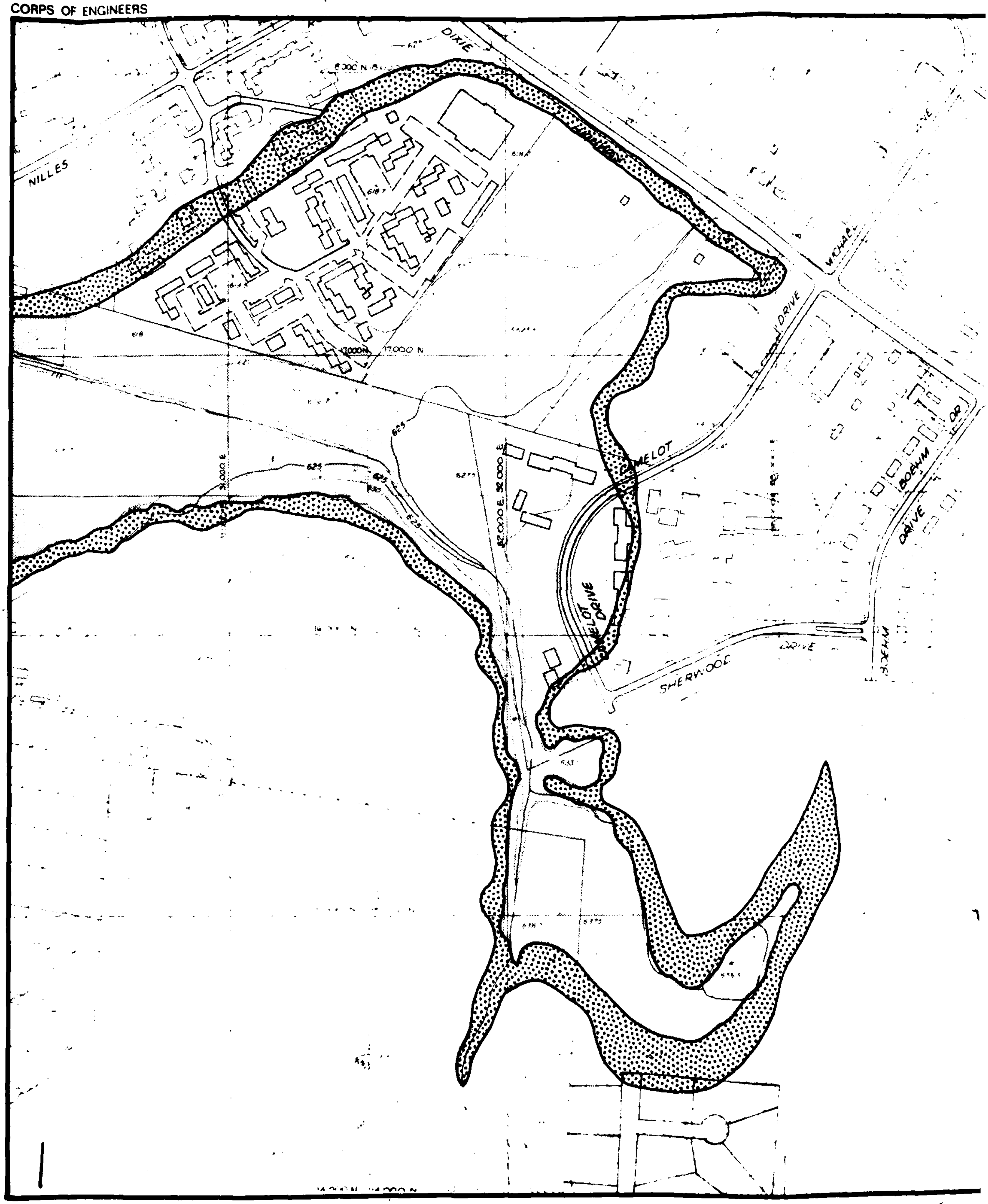


MIAMI RIVER BASIN
FAIRFIELD, OHIO

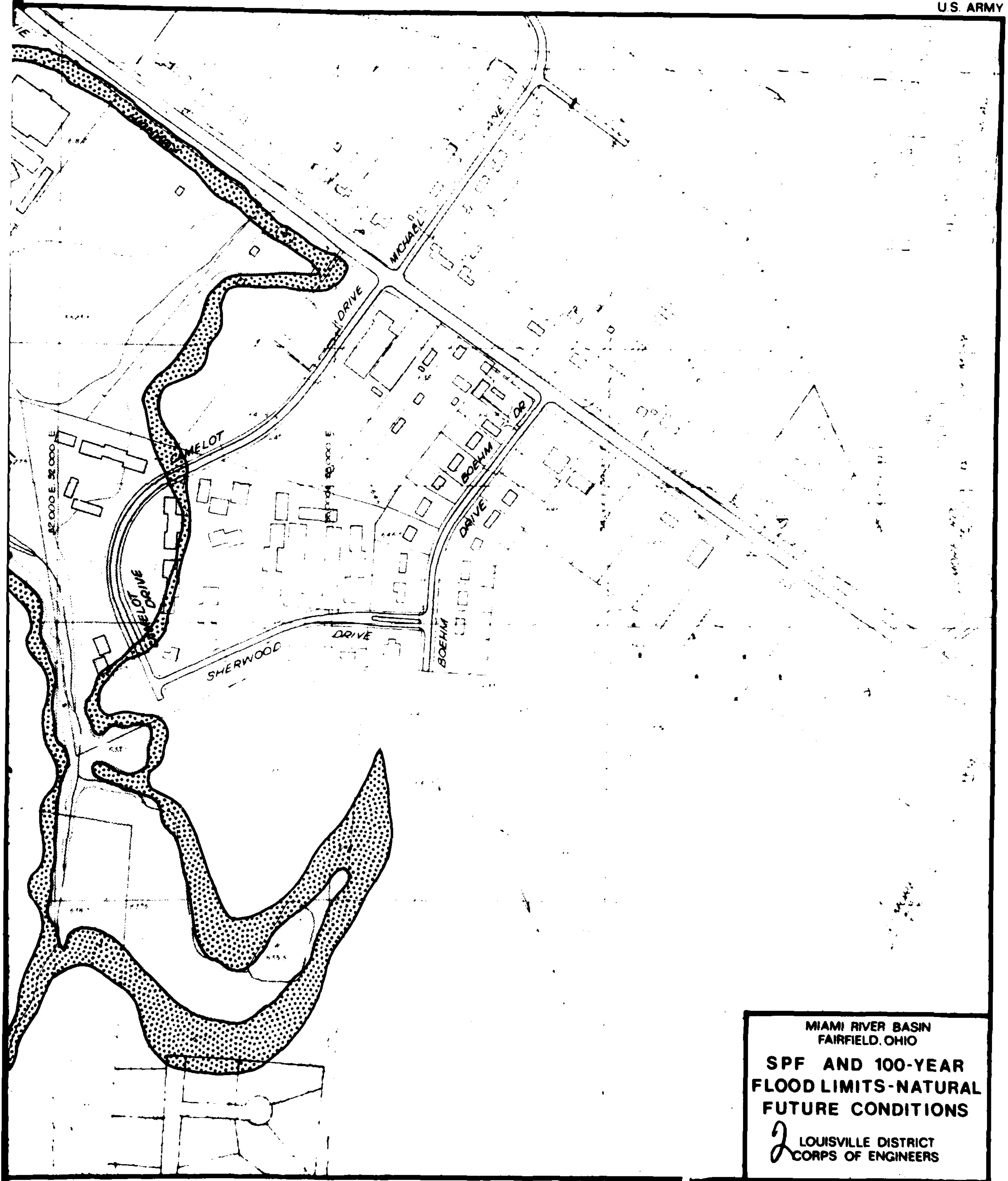
SPF AND 100-YEAR
FLOOD LIMITS-NATURAL
FUTURE CONDITIONS

LOUISVILLE DISTRICT
CORPS OF ENGINEERS

CORPS OF ENGINEERS



U.S. ARMY

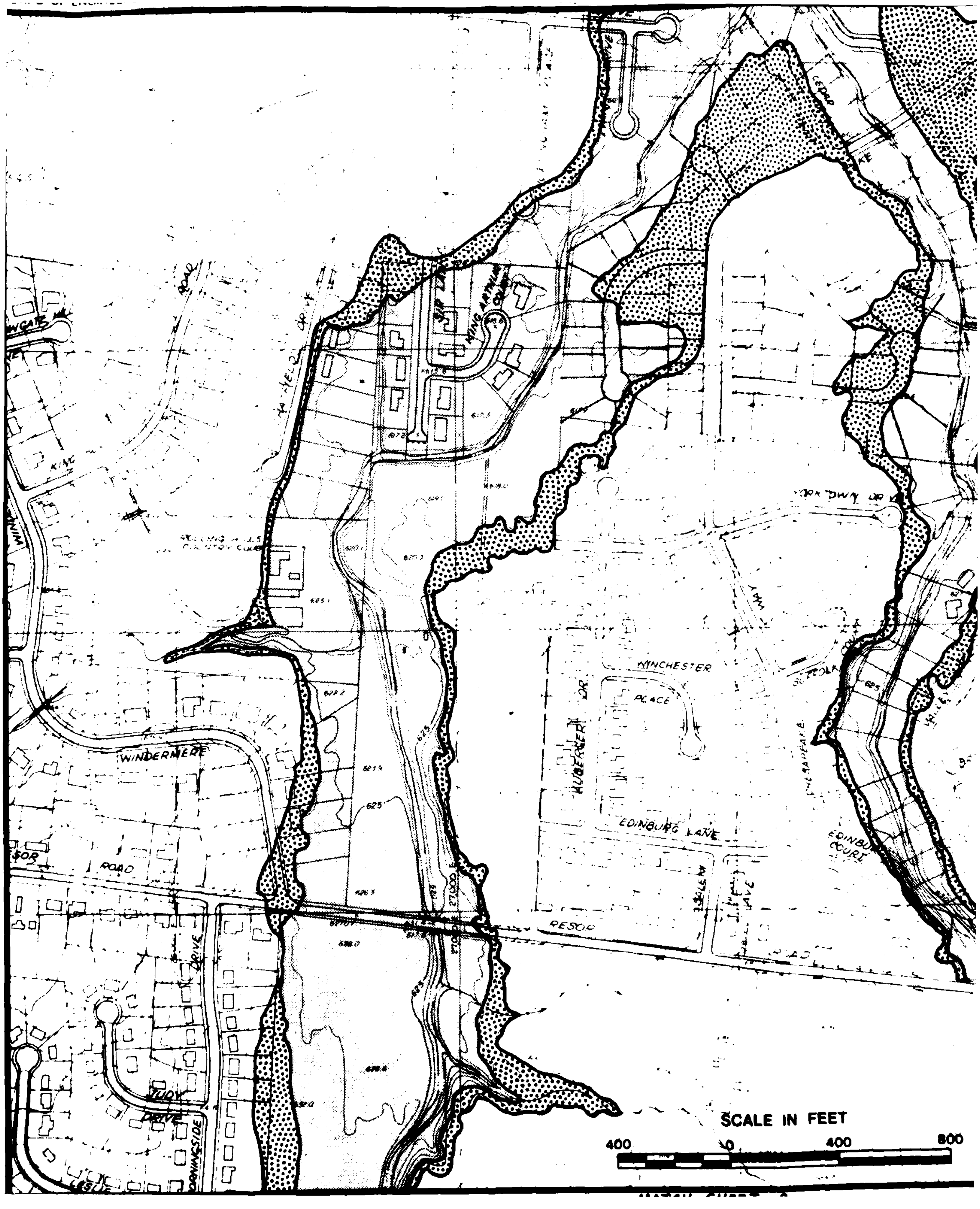


MIAMI RIVER BASIN
FAIRFIELD, OHIO

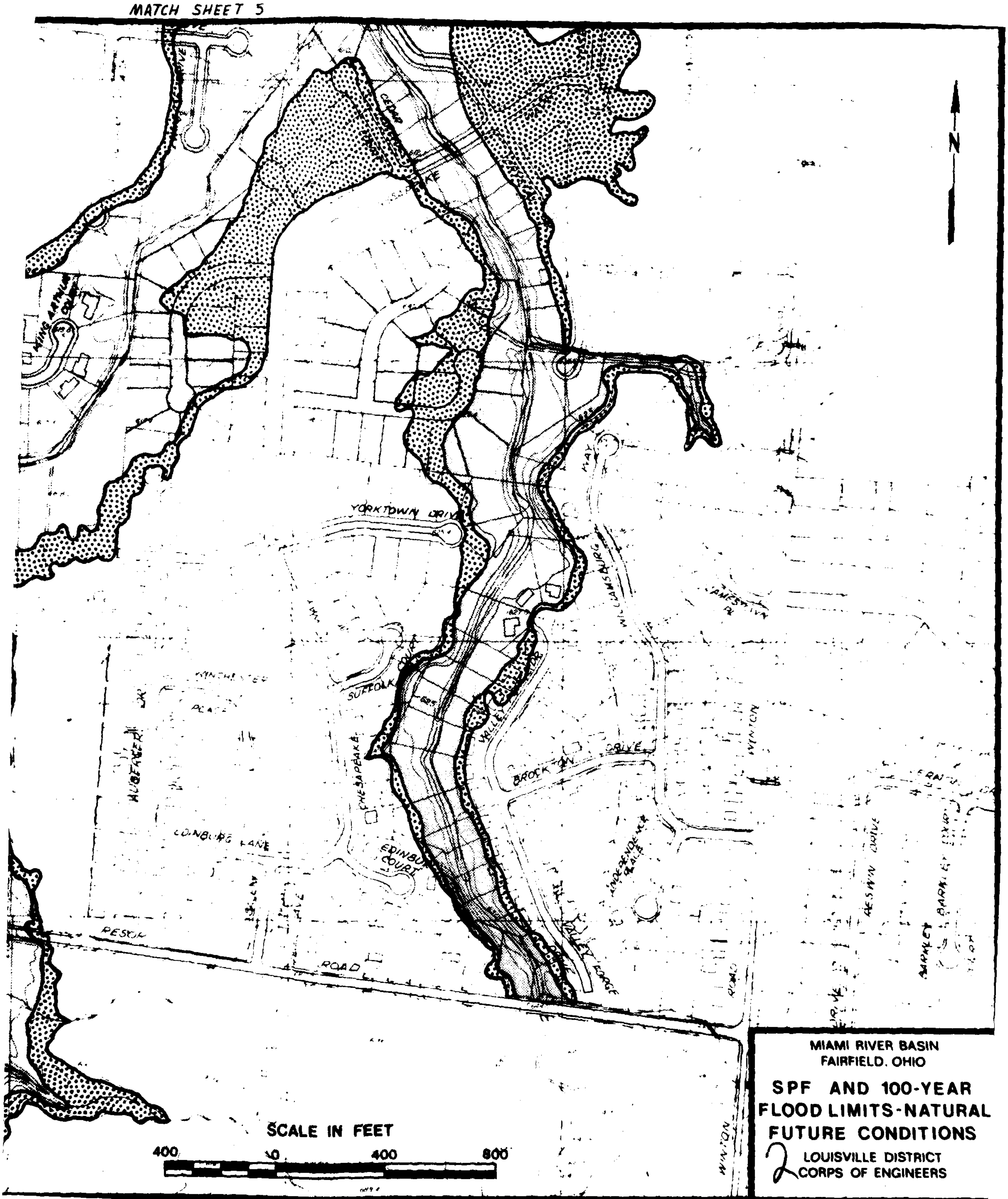
SPF AND 100-YEAR FLOOD LIMITS-NATURAL FUTURE CONDITIONS

LOUISVILLE DISTRICT
CORPS OF ENGINEERS

SHEET 6 OF 9 PLATE D-76


ROAD
MAYFIELD DRIVE
KING ARTHUR COURT
WINDERMERE
ROAD
DRIVE
ROAD
TUDY
DRIVE
MORNINGSIDE
WINCHESTER
PLACE
AUBERGER DR
EDINBURG LANE
EDINBURG COURT
CHESAPEAKE
SUFFOLK
WAY
RESOR
ROAD
SCALE IN FEET
400
0
400
800

MATCH SHEET 5



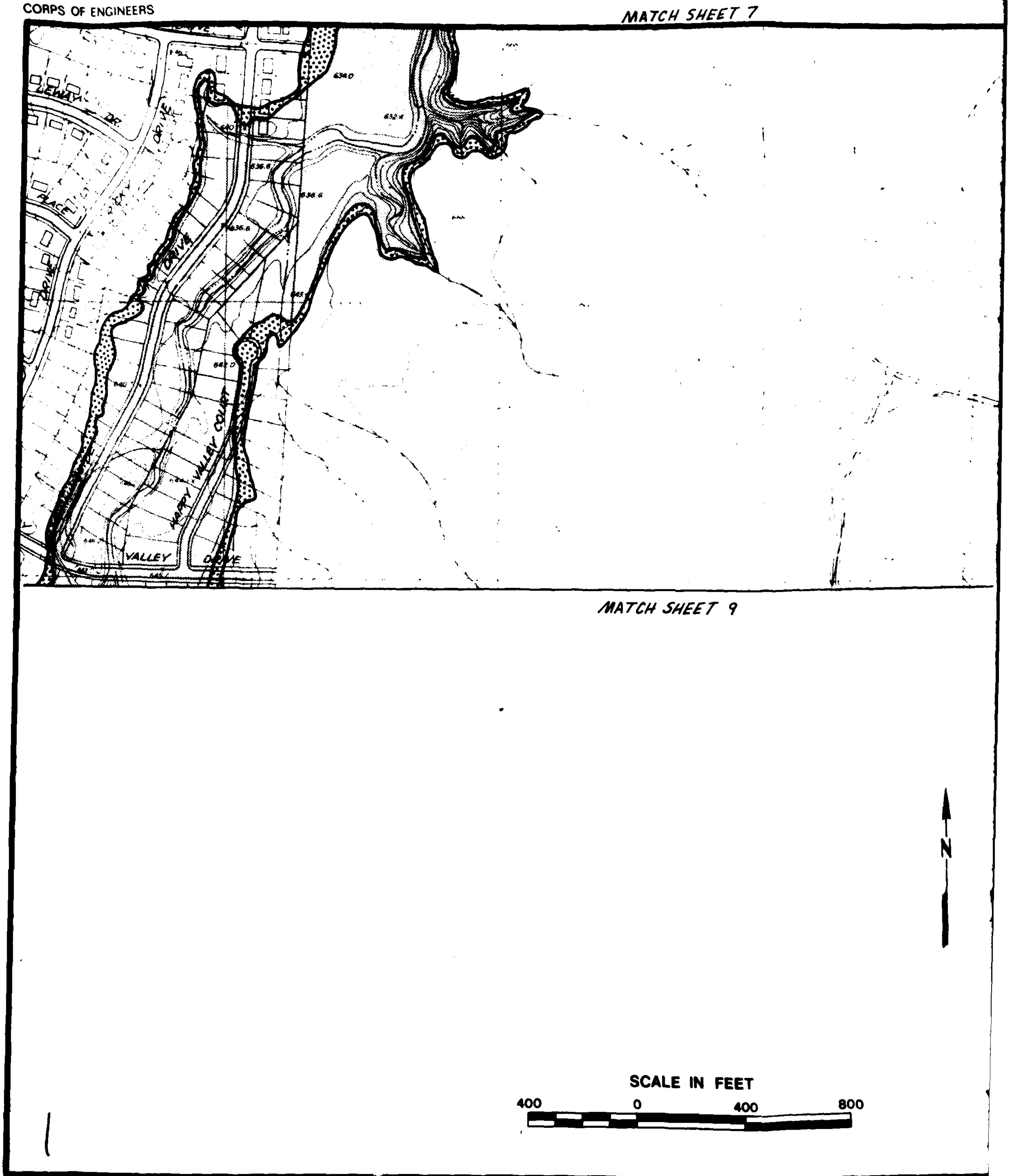
MIAMI RIVER BASIN
FAIRFIELD, OHIO

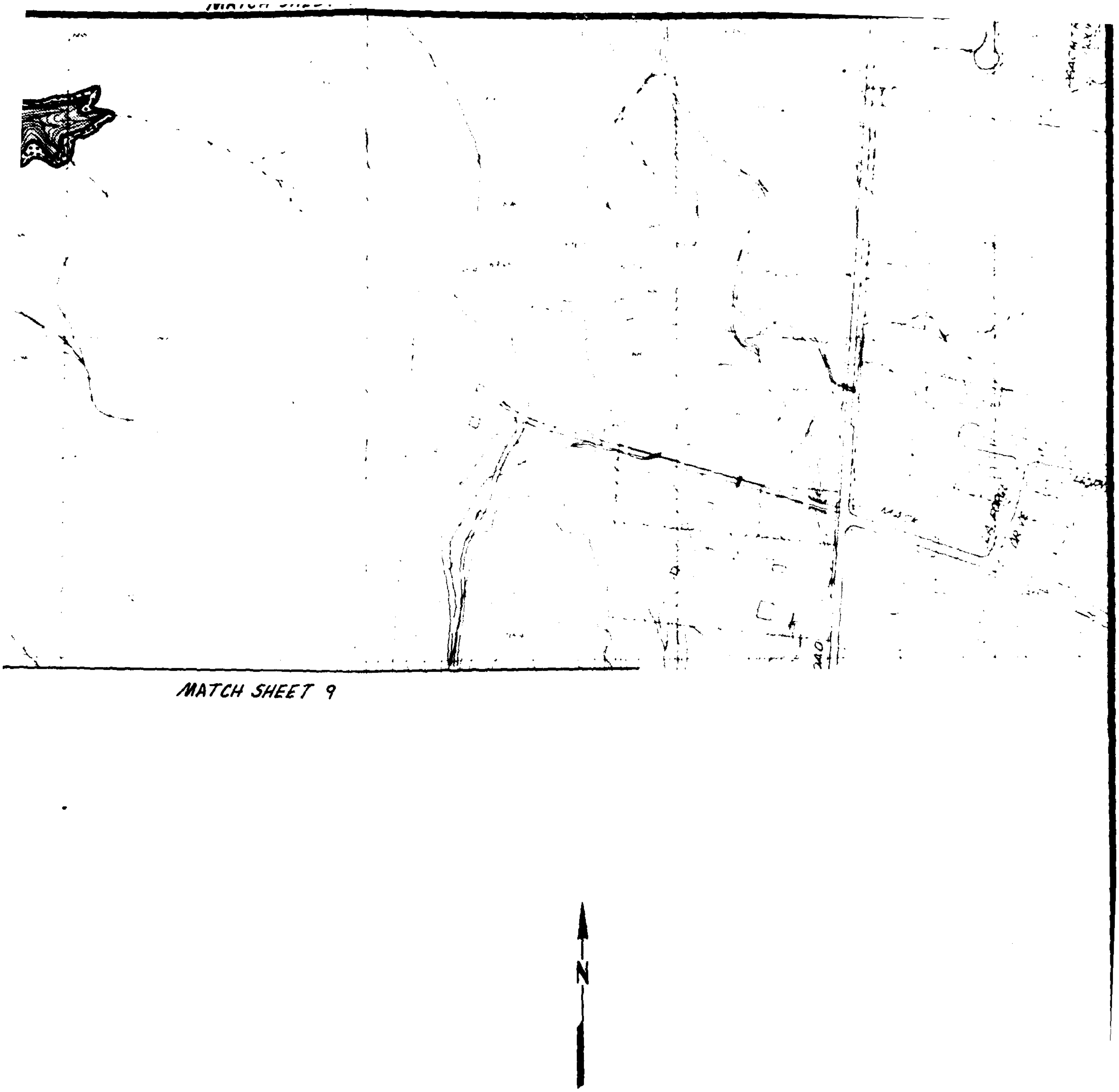
SPF AND 100-YEAR FLOOD LIMITS-NATURAL FUTURE CONDITIONS

LOUISVILLE DISTRICT
CORPS OF ENGINEERS

SHEET 7 OF 9 PLATE D-7

CORPS OF ENGINEERS





SCALE IN FEET

400 0 400 800

MIAMI RIVER BASIN
FAIRFIELD, OHIO

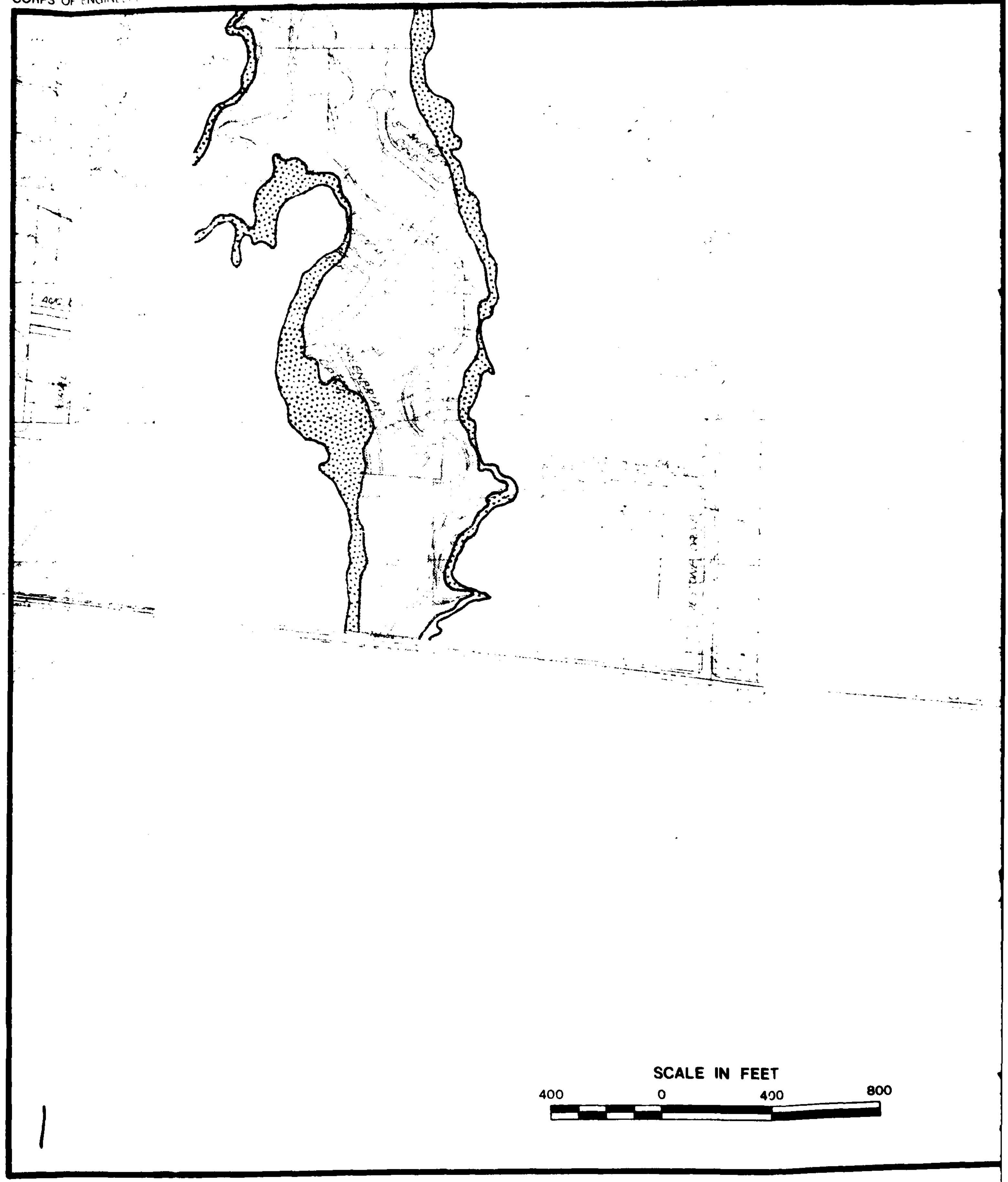
SPF AND 100-YEAR FLOOD LIMITS-NATURAL FUTURE CONDITIONS

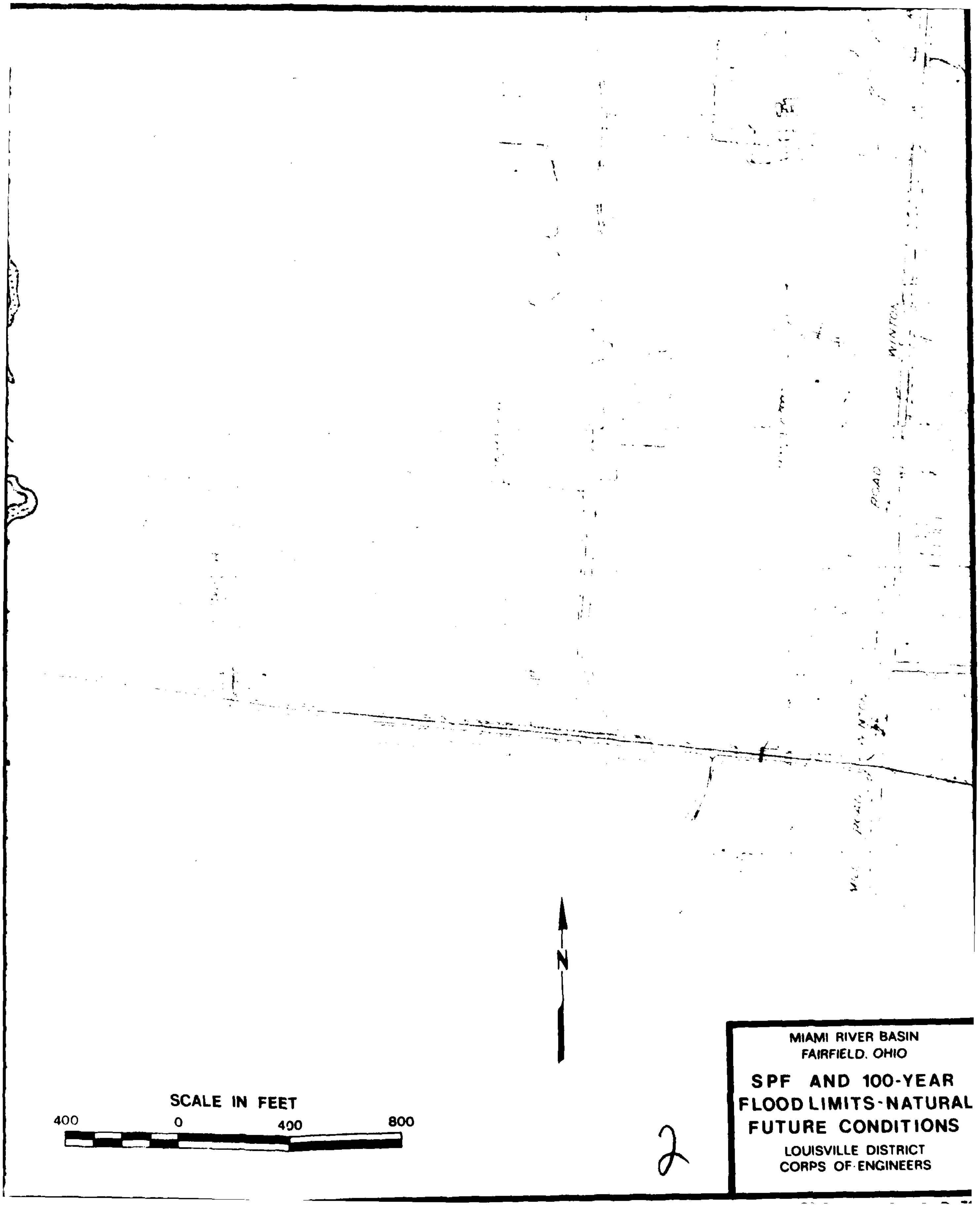
LOUISVILLE DISTRICT
CORPS OF ENGINEERS

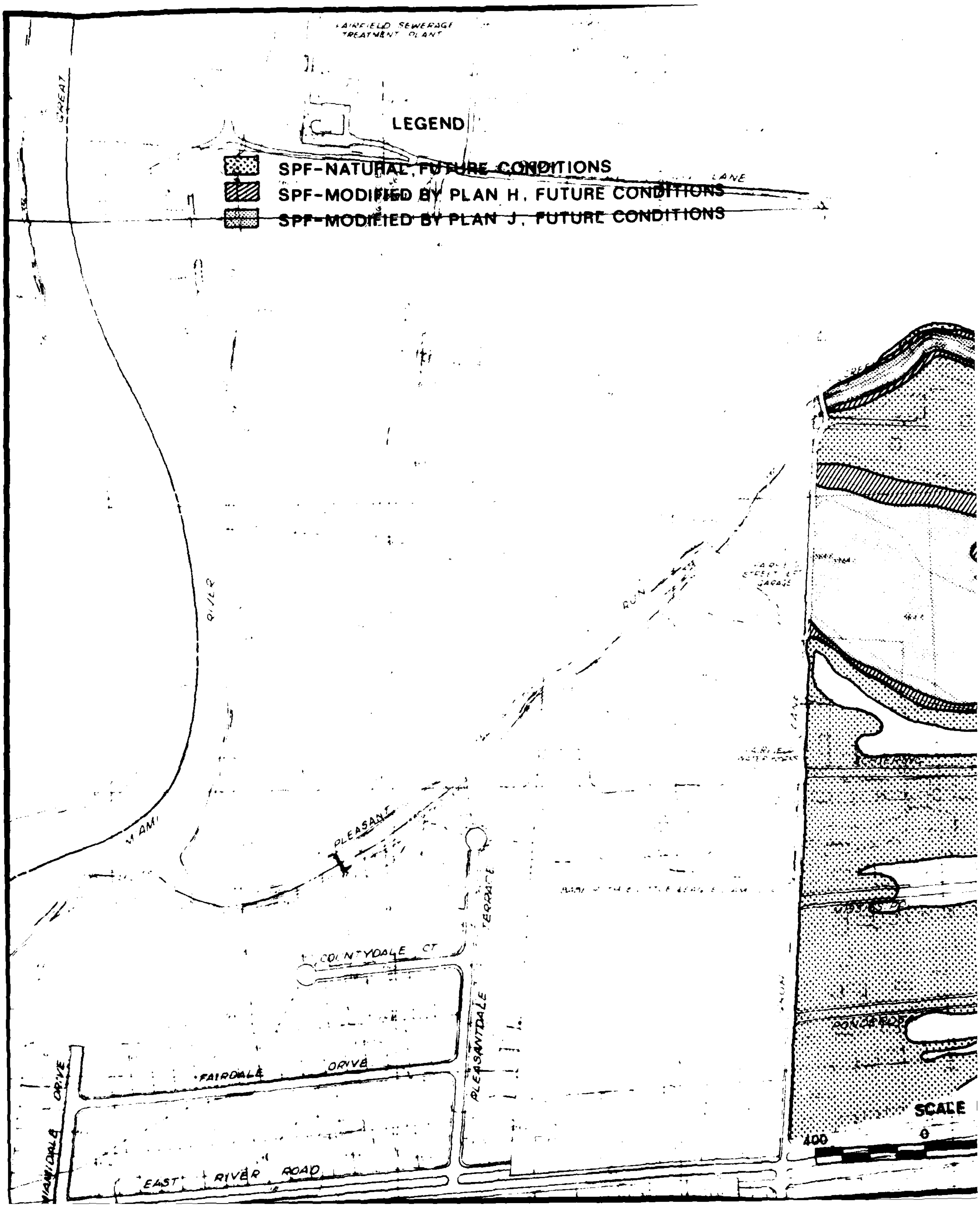
2

CORPS OF ENGINEERS

MATCH SHEET 8

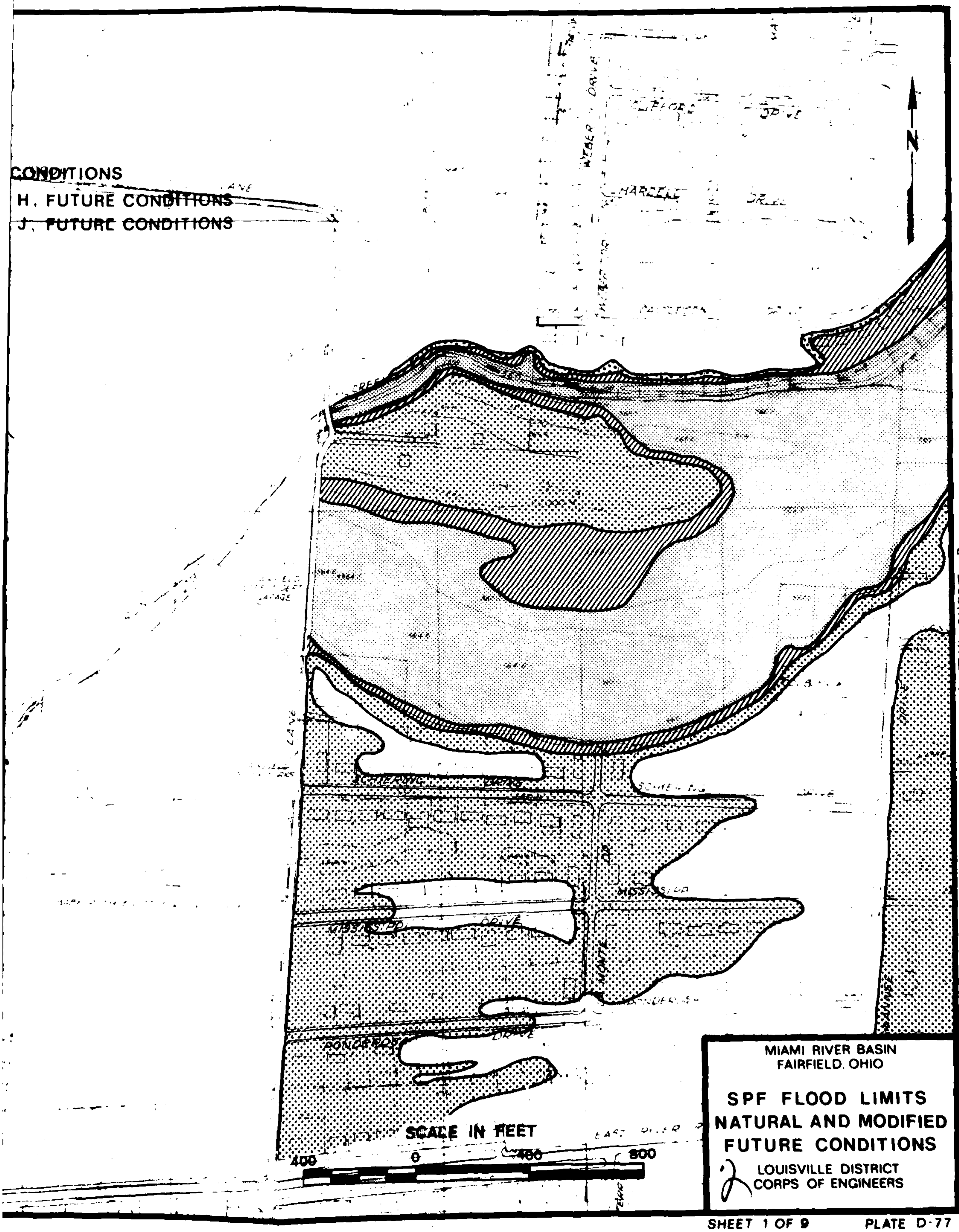



WINTON
ROAD
N
SCALE IN FEET
400
0
400
800
2
MIAMI RIVER BASIN
FAIRFIELD, OHIO
SPF AND 100-YEAR
FLOOD LIMITS-NATURAL
FUTURE CONDITIONS
LOUISVILLE DISTRICT
CORPS OF ENGINEERS

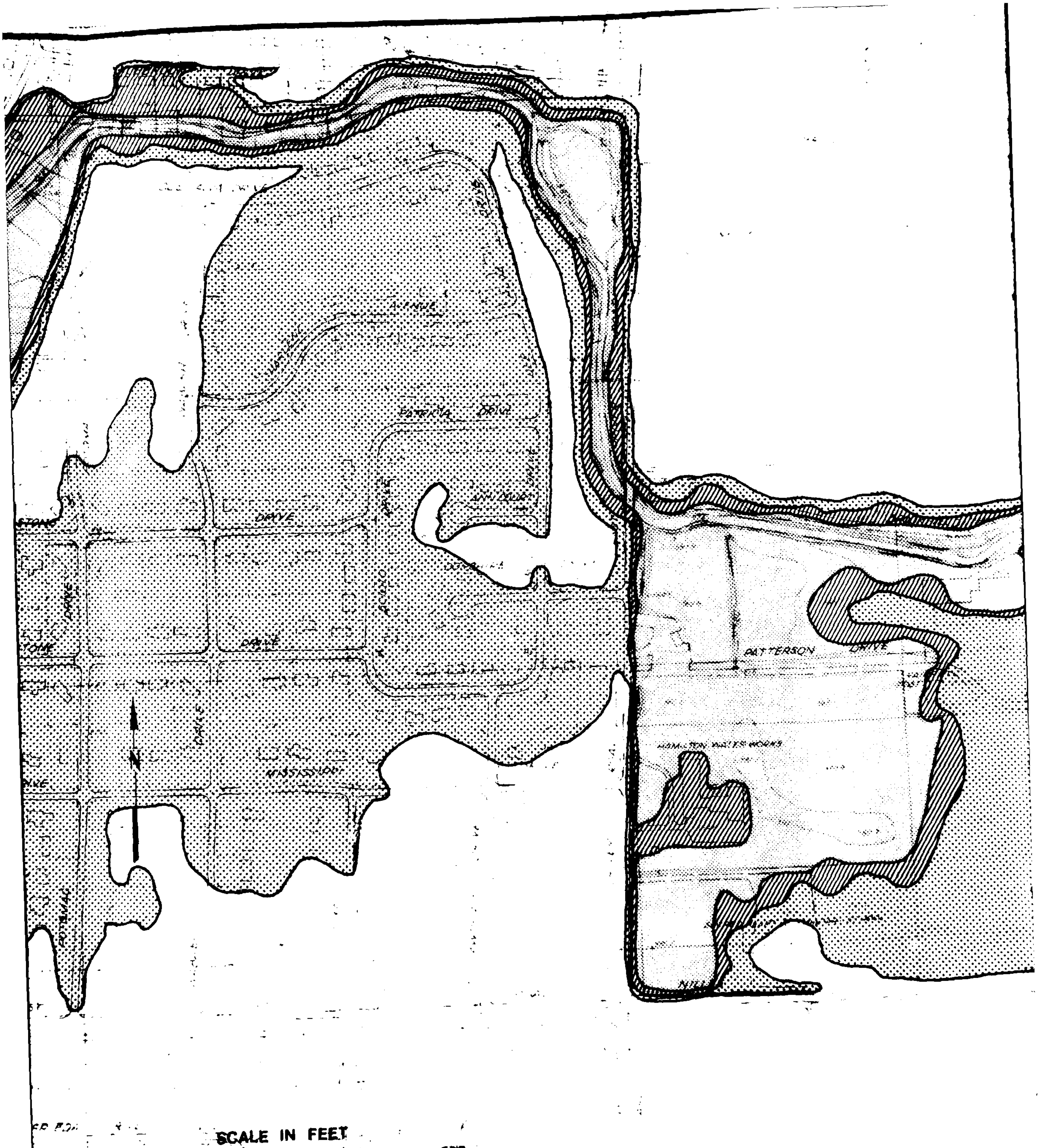


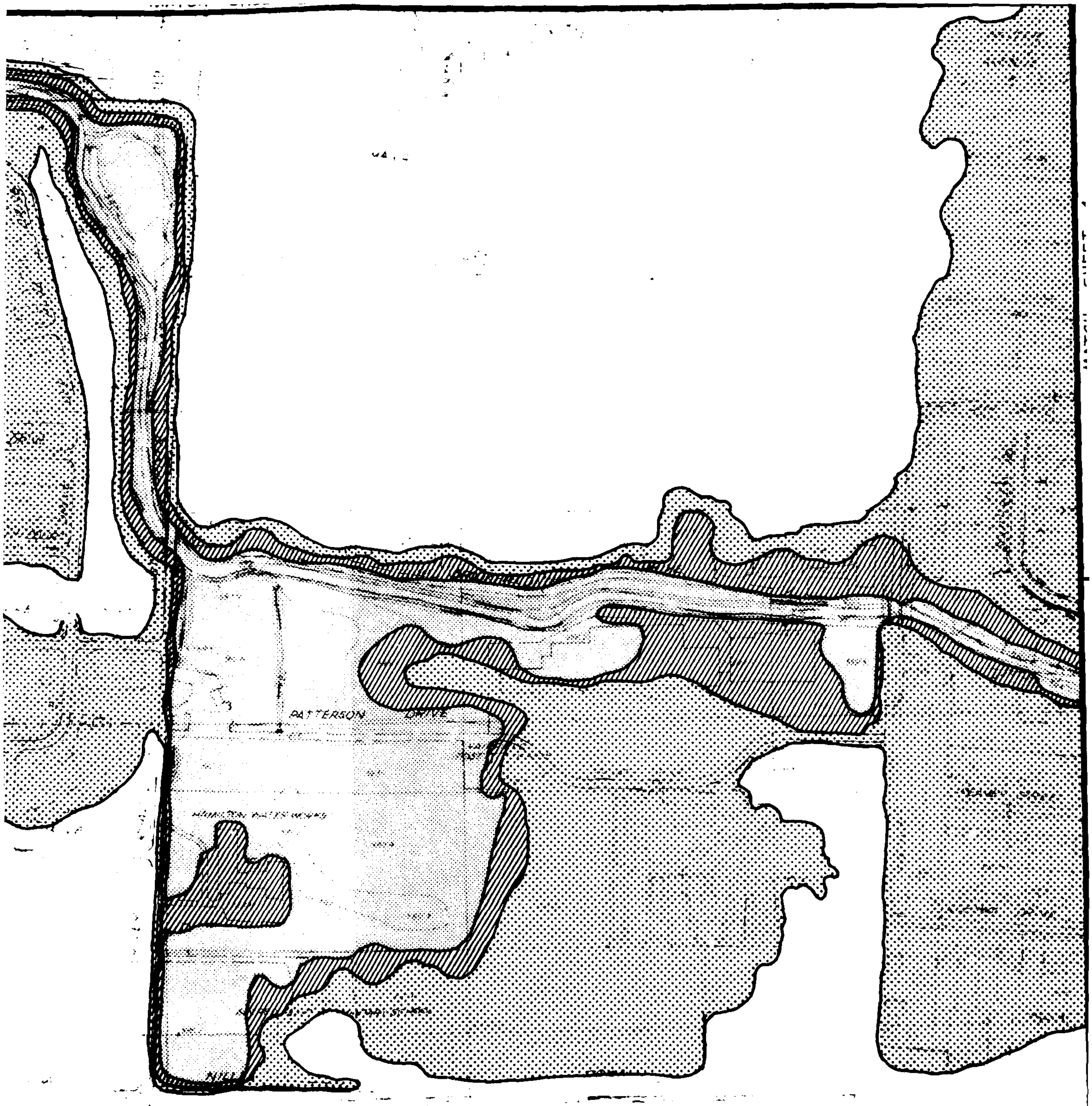
FAIRFIELD SEWERAGE TREATMENT PLANT
LEGEND
SPF-NATURAL, FUTURE CONDITIONS
SPF-MODIFIED BY PLAN H, FUTURE CONDITIONS
SPF-MODIFIED BY PLAN J, FUTURE CONDITIONS
GREAT
MIAMI
RIVER
LANE
RUN
PLEASANT
TERRACE
COUNTYDALE CT
PLEASANTDALE
FAIRDALE DRIVE
MIAMIDALE DRIVE
EAST RIVER ROAD
SCALE
400
0

U.S. ARMY



SHEET 1 OF 9 PLATE D-77


SCALE IN FEET
400
0
400
800
PATTERSON
DRIVE
DRIVE
DRIVE

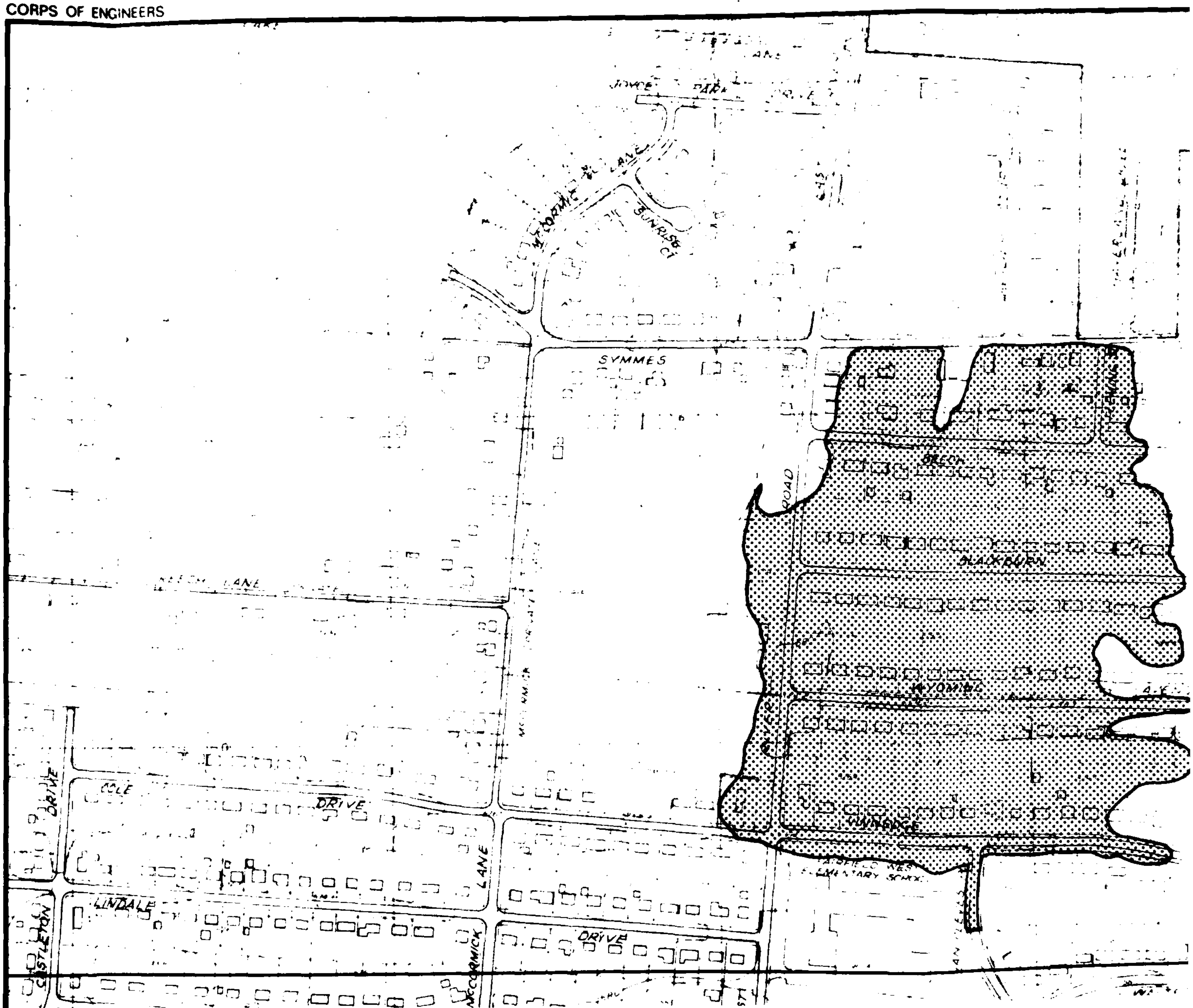


MIAMI RIVER BASIN
FAIRFIELD, OHIO

SPF FLOOD LIMITS NATURAL AND MODIFIED FUTURE CONDITIONS

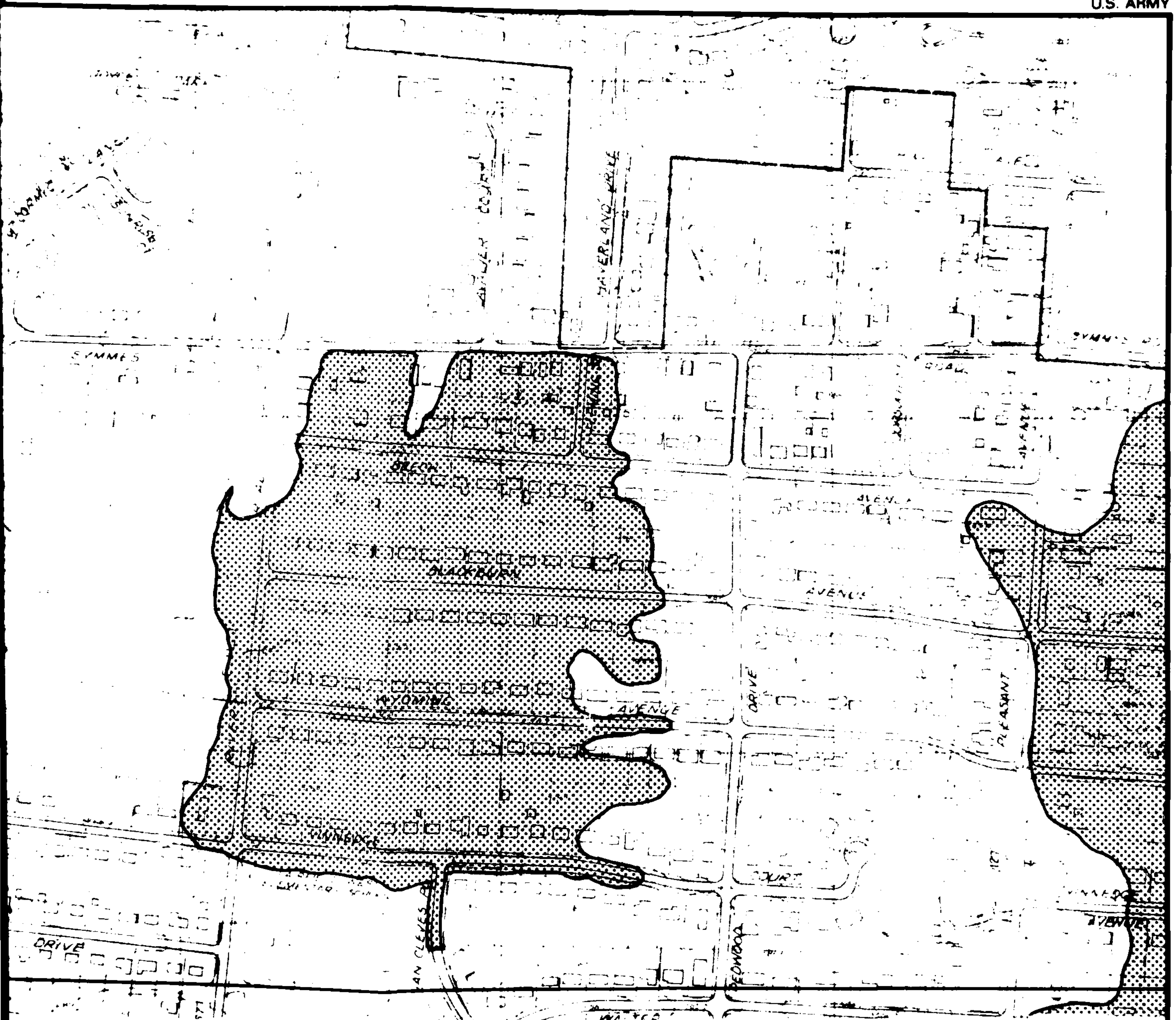
LOUISVILLE DISTRICT
CORPS OF ENGINEERS

CORPS OF ENGINEERS



MATCH SHEET 2

U.S. ARMY



MATCH SHEET 2

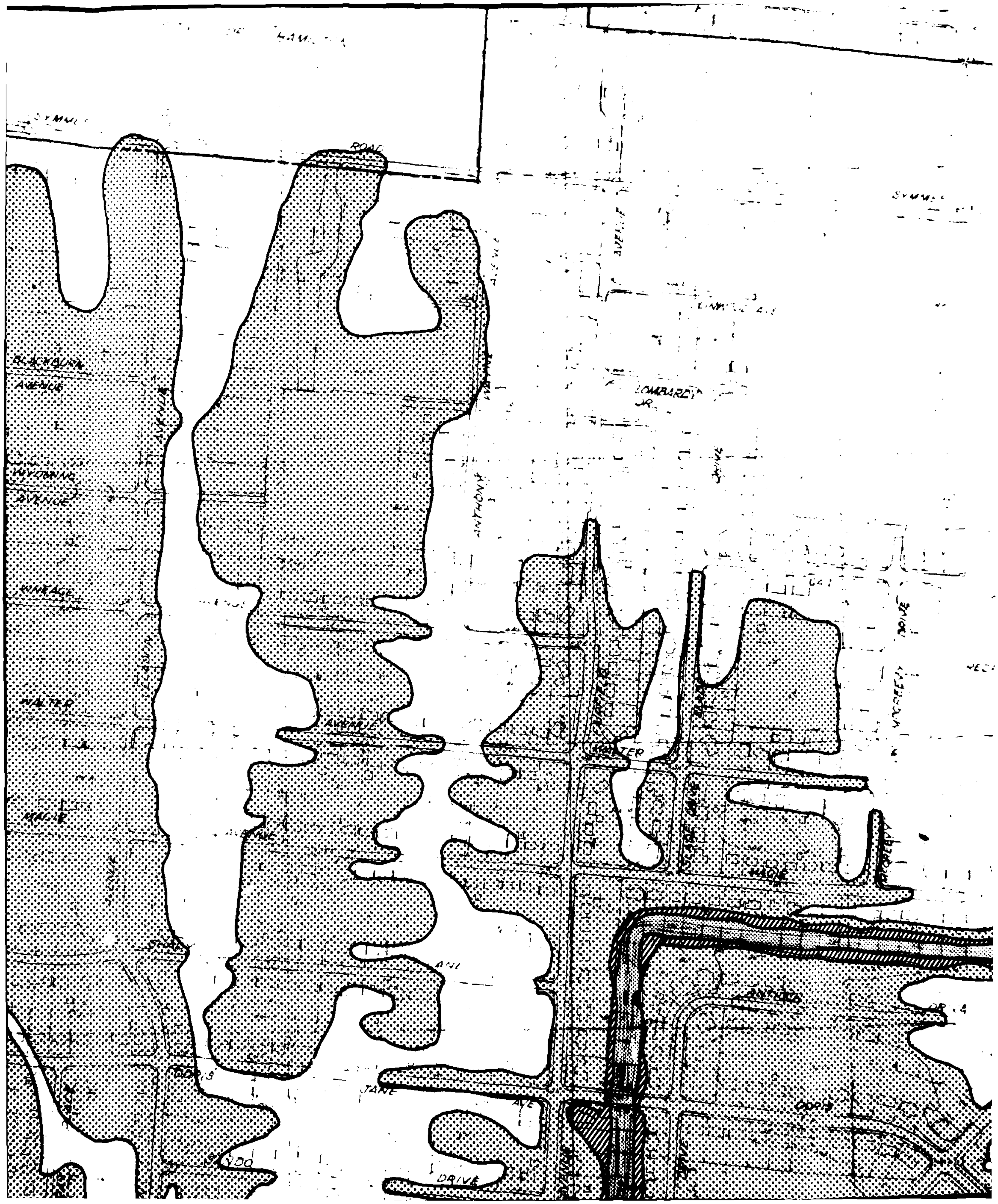
2

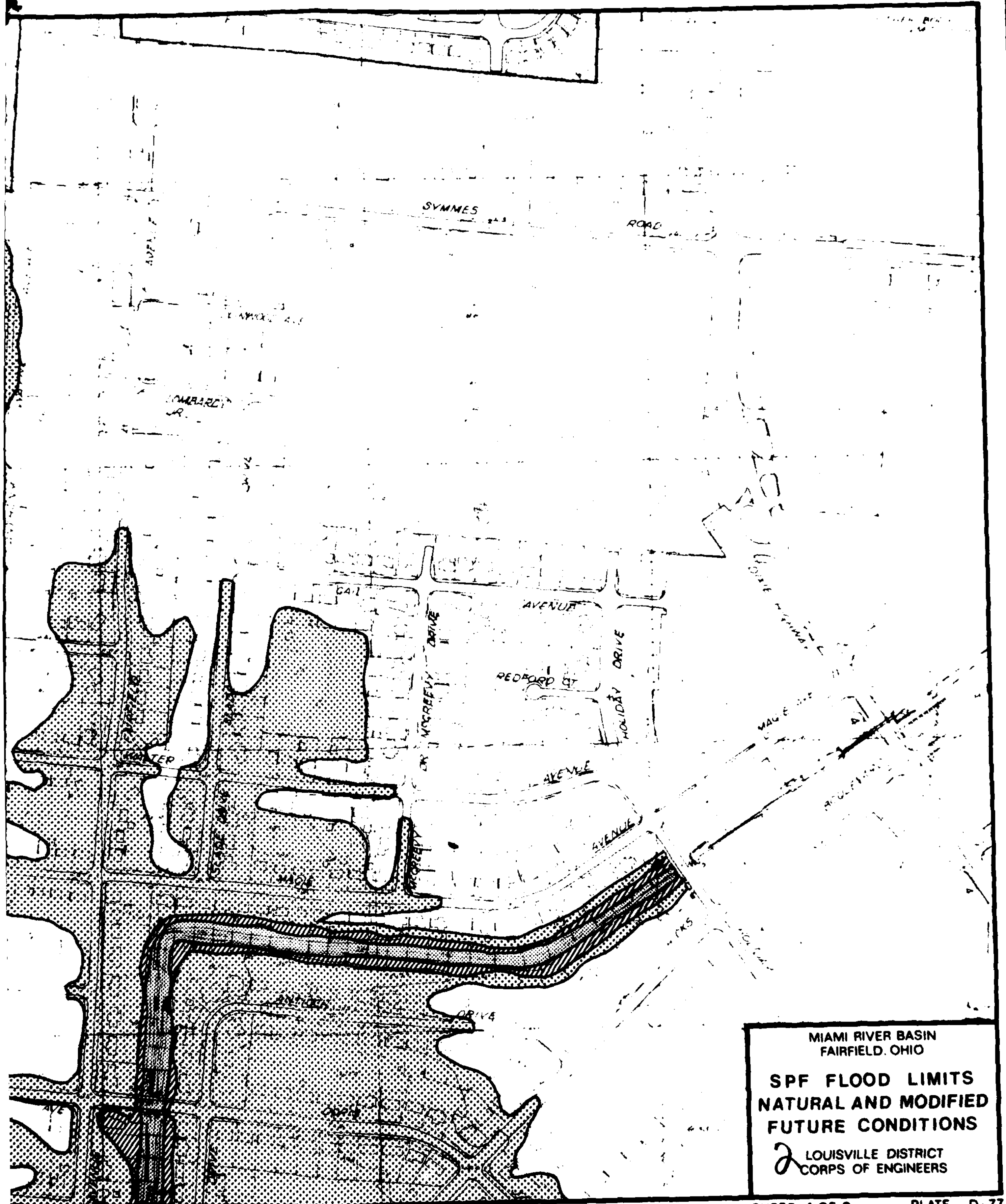
MIAMI RIVER BASIN
FAIRFIELD, OHIO

SPF FLOOD LIMITS
NATURAL AND MODIFIED
FUTURE CONDITIONS

LOUISVILLE DISTRICT
CORPS OF ENGINEERS

SHEET 3 OF 9 PLATE D-77


ROAD
SYMMES
BLACKBURN
AVENUE
WYOMING
AVENUE
WINEAGE
AVENUE
WALTER
MAGIE
ANTHONY
LOMBARDY
DR.
WALTER
MAGIE
DRIVE
DORIS
JANE
AVE
DRIVE
RONDO



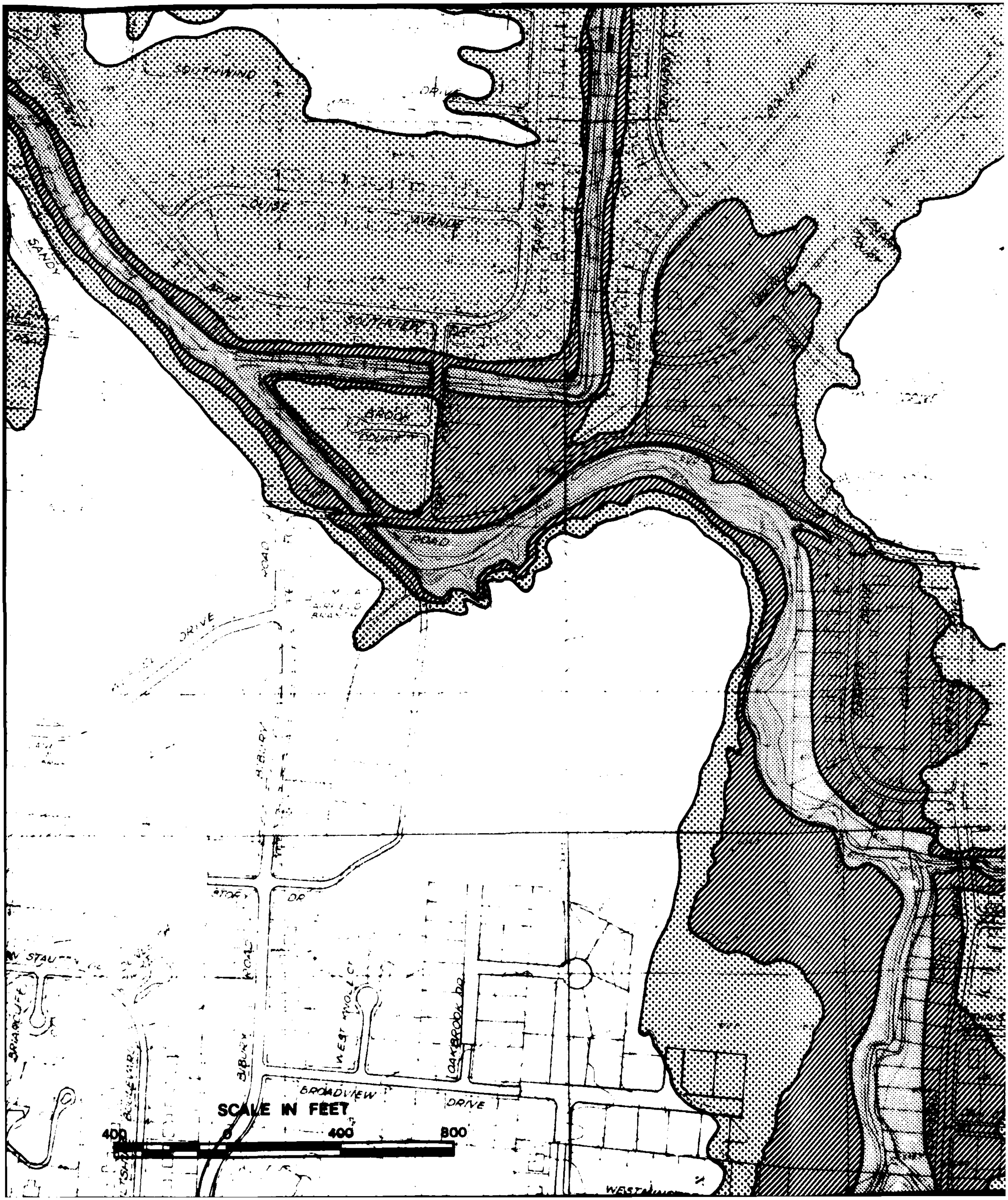
MIAMI RIVER BASIN
FAIRFIELD, OHIO

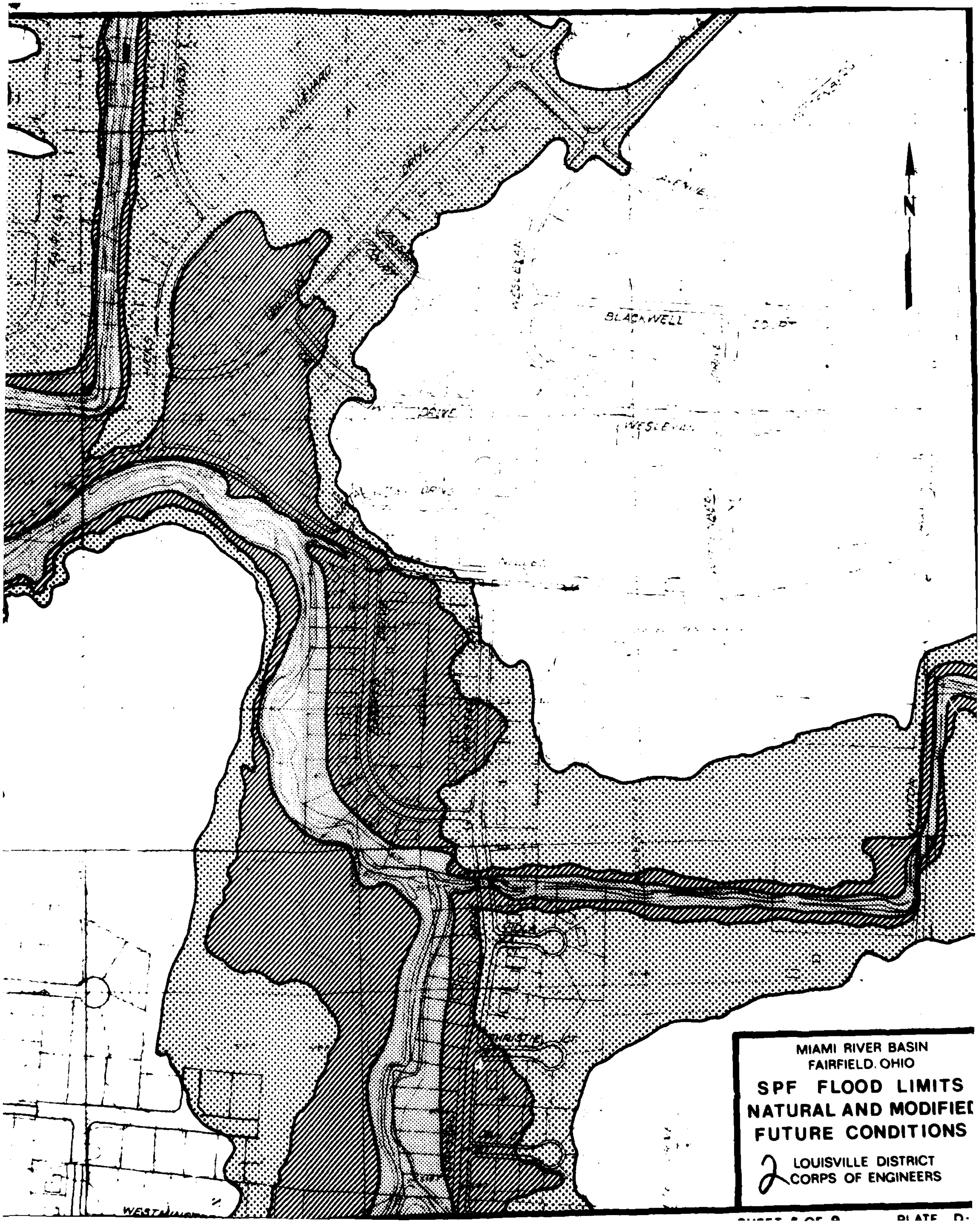
SPF FLOOD LIMITS
NATURAL AND MODIFIED
FUTURE CONDITIONS

LOUISVILLE DISTRICT
CORPS OF ENGINEERS

U.S. ARMY

MATCH SHEET 5


SCALE IN FEET
400
0
400
800
BROADVIEW
DRIVE
OAKBROOK DR
BIBURY
SANDY
DRIVE



MIAMI RIVER BASIN
FAIRFIELD, OHIO

SPF FLOOD LIMITS
NATURAL AND MODIFIE[D]
FUTURE CONDITIONS

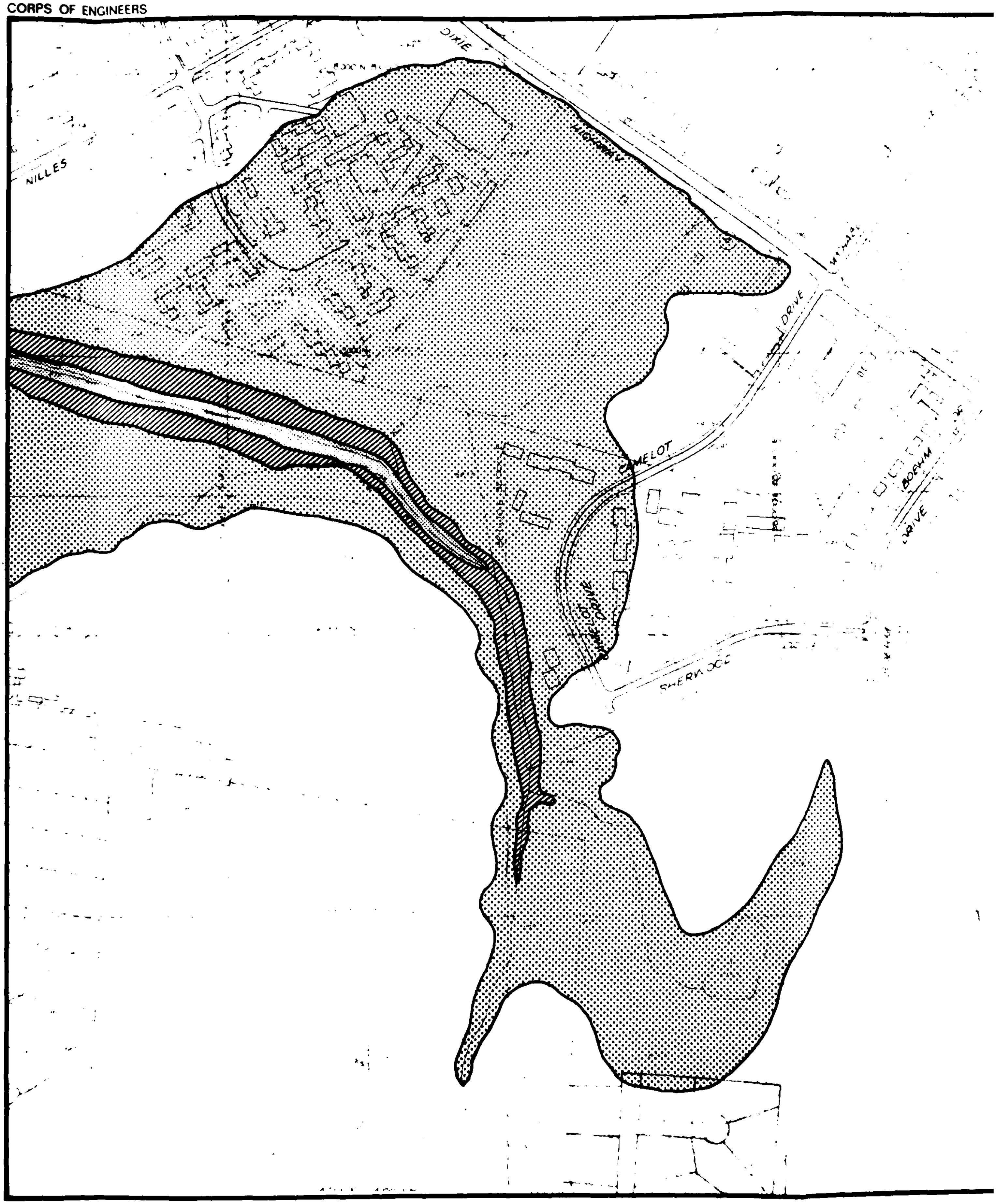
2

LOUISVILLE DISTRICT
CORPS OF ENGINEERS

SHEET 2 OF 8 PLATE D-

CORPS OF ENGINEERS

MATCH SHEET 5



U.S. ARMY

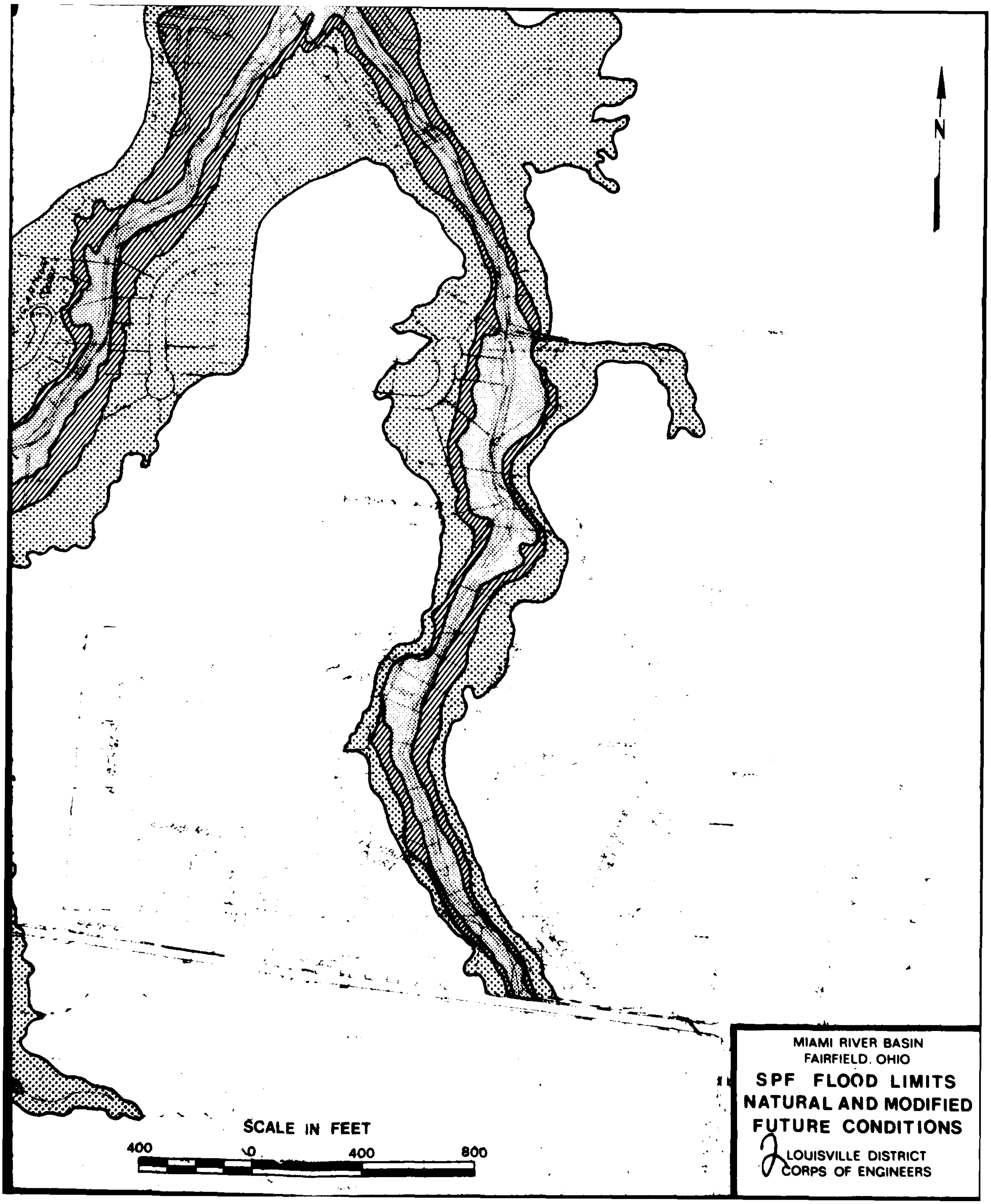
MIAMI RIVER BASIN
FAIRFIELD, OHIO

SPF FLOOD LIMITS
NATURAL AND MODIFIED
FUTURE CONDITIONS

LOUISVILLE DISTRICT
CORPS OF ENGINEERS

SHEET 6 OF 9 PLATE D-77

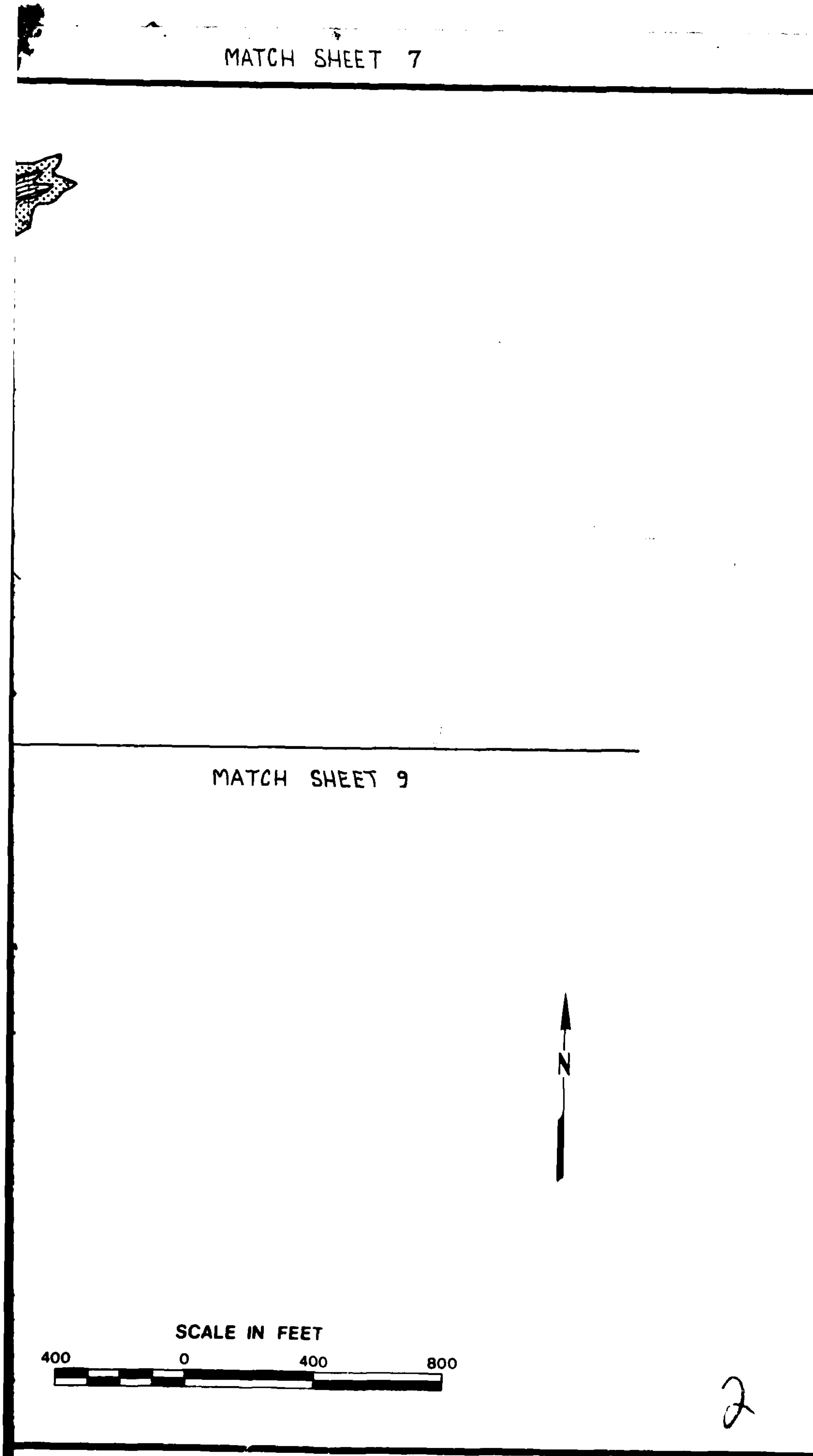
WINDERMERE
JUDY
DRIVE
SCALE IN FEET
400
0
400
800


N
SCALE IN FEET
400
0
400
800
MIAMI RIVER BASIN
FAIRFIELD, OHIO
SPF FLOOD LIMITS
NATURAL AND MODIFIED
FUTURE CONDITIONS
LOUISVILLE DISTRICT
CORPS OF ENGINEERS

MATCH SHEET 9

SCALE IN FEET

400 0 400 800



U S ARMY

MIAMI RIVER BASIN
FAIRFIELD, OHIO

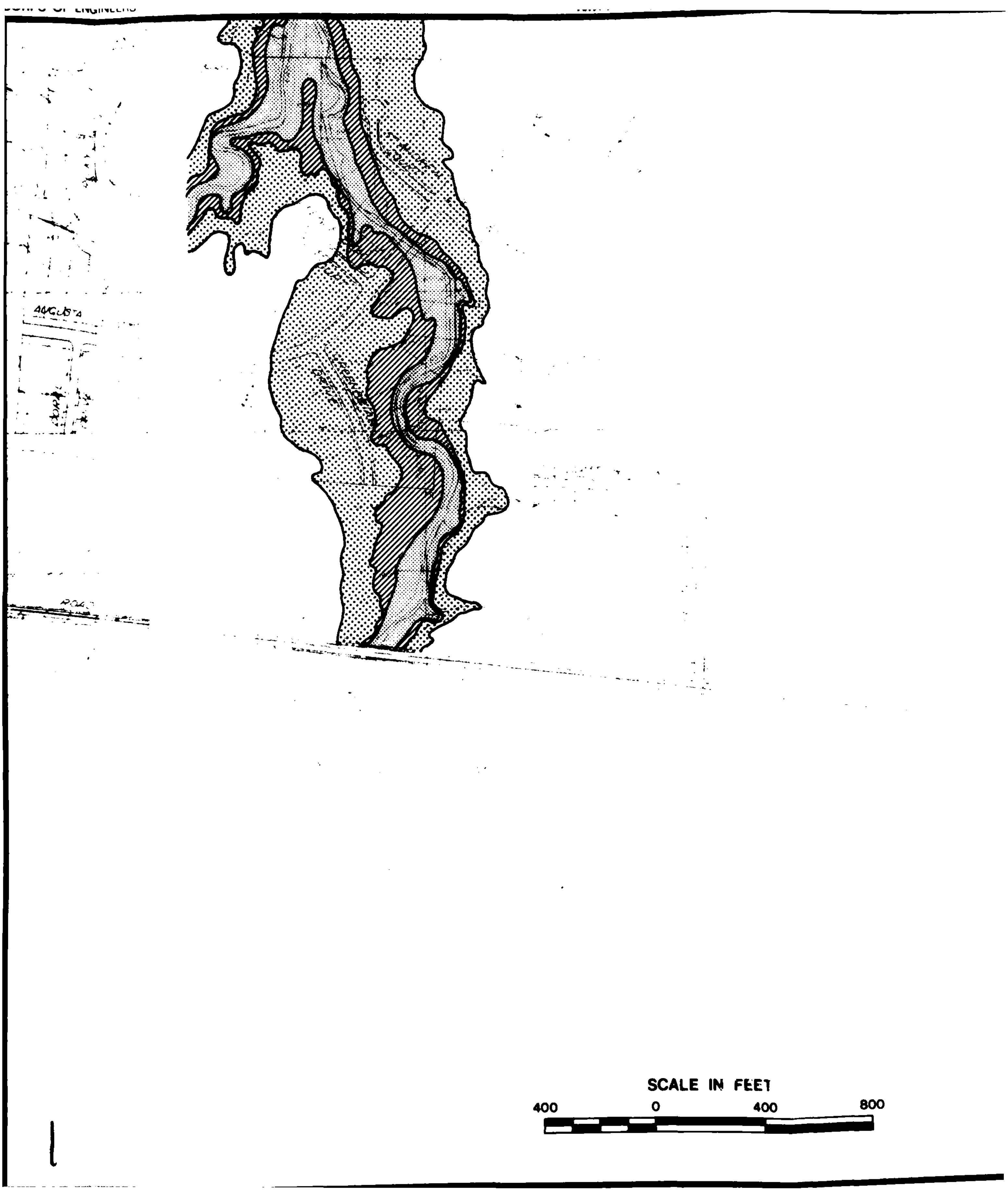
SPF FLOOD LIMITS NATURAL AND MODIFIED FUTURE CONDITIONS

LOUISVILLE DISTRICT
CORPS OF ENGINEERS

AD-A111 738 ARMY ENGINEER DISTRICT LOUISVILLE KY F/G 13/2
WATER RESOURCES DEVELOPMENT MIAMI RIVER, LITTLE MIAMI RIVER, AN--ETC(U)
OCT 81

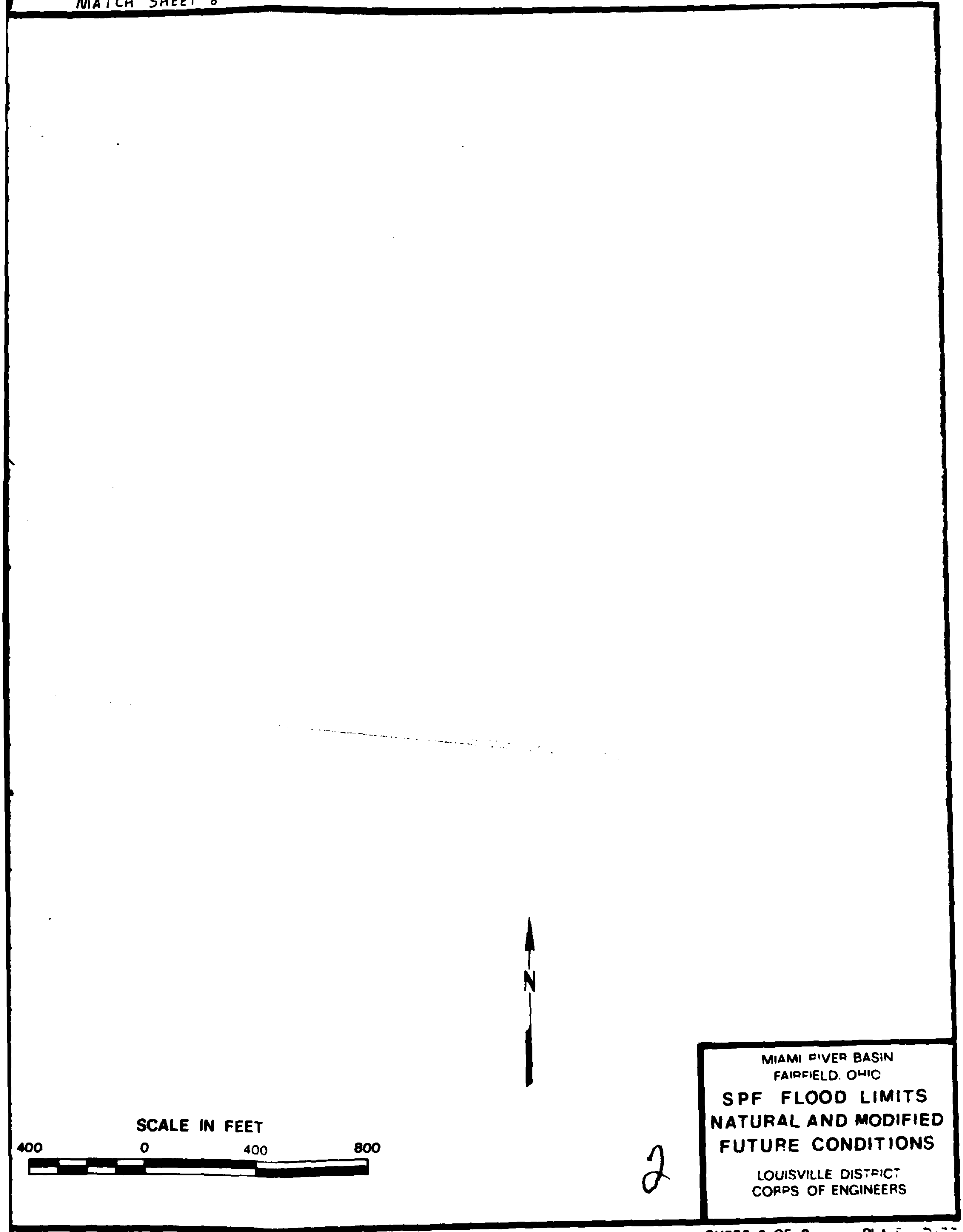
UNCLASSIFIED NL

5 of 6


AUGUSTA
ROAD
SCALE IN FEET
400
0
400
800

MATCH SHEET 8

U.S. ARMY



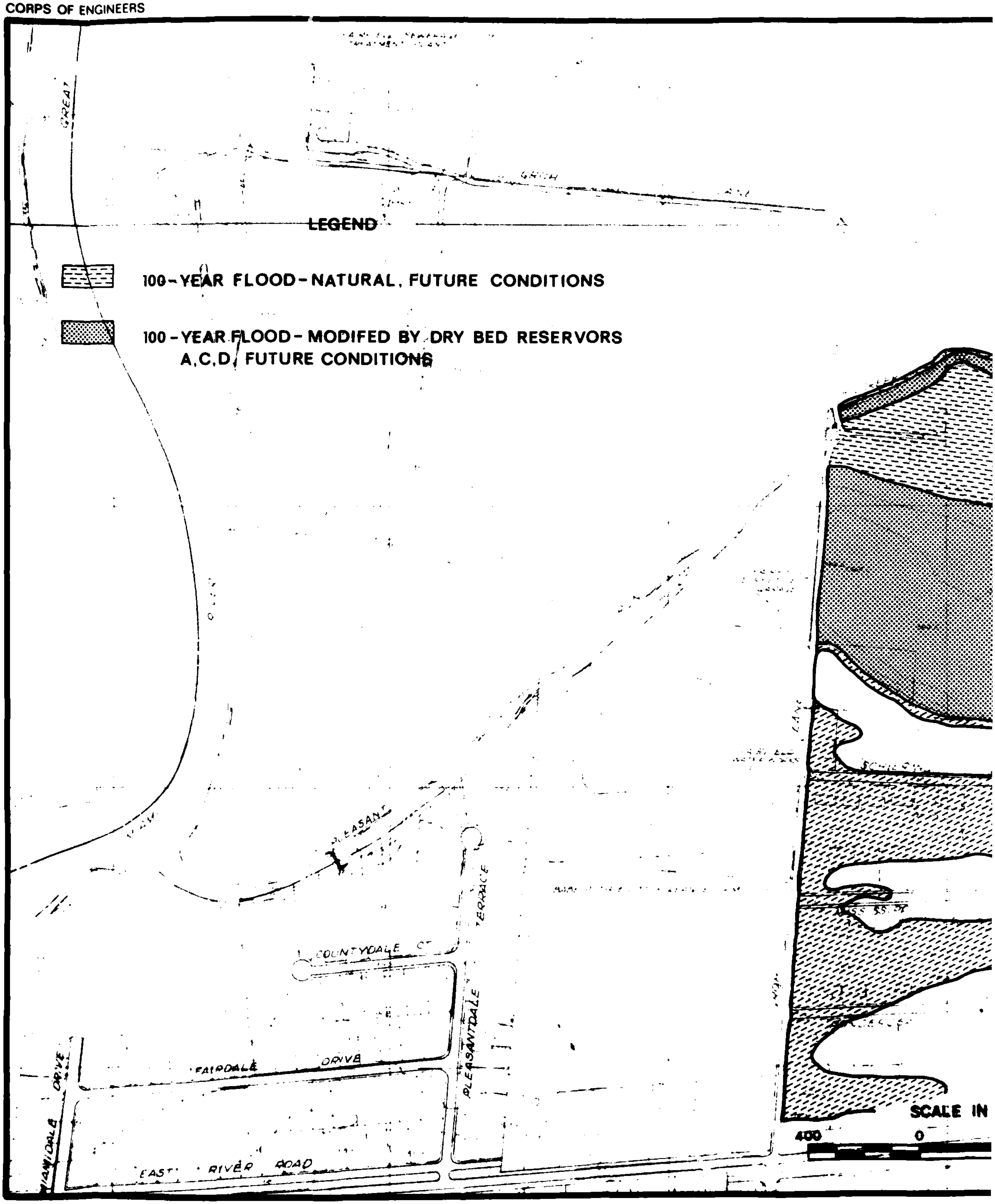
MIAMI RIVER BASIN
FAIRFIELD, OHIO

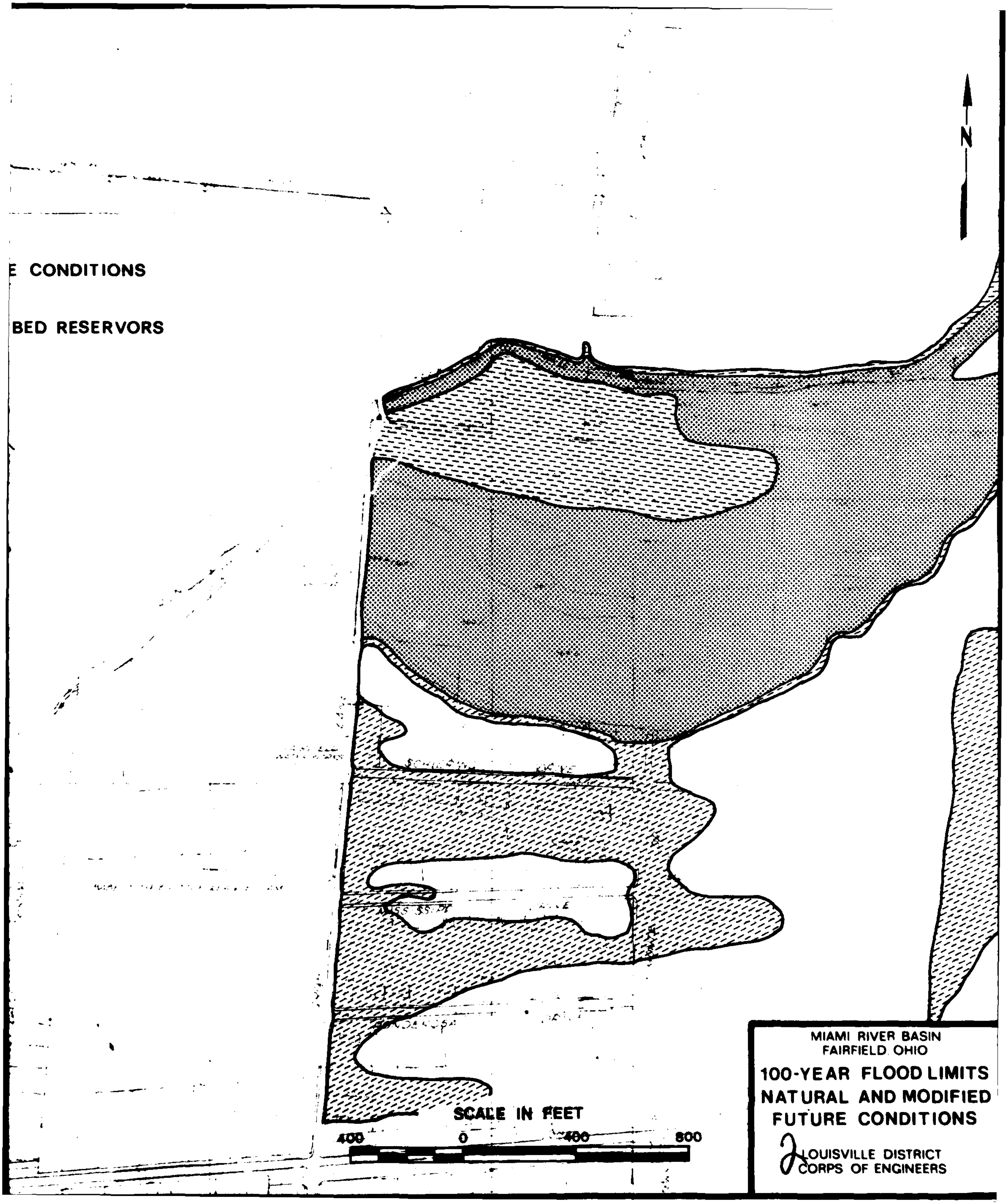
SPF FLOOD LIMITS
NATURAL AND MODIFIED
FUTURE CONDITIONS

LOUISVILLE DISTRICT
CORPS OF ENGINEERS

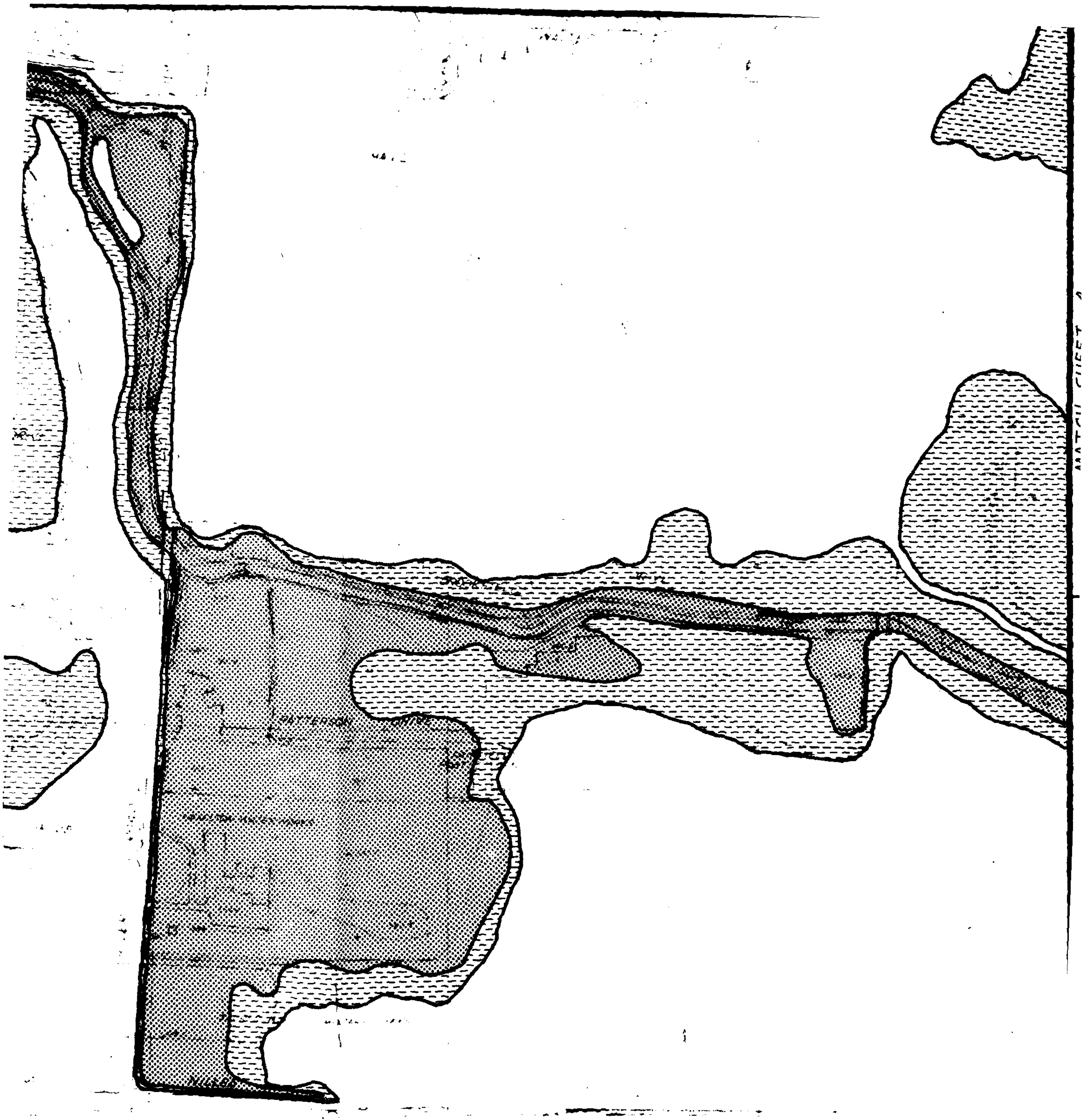
SHEET 9 OF 9 PLA[illegible] D-77

CORPS OF ENGINEERS




E CONDITIONS
BED RESERVORS
N
SCALE IN FEET
400
0
400
800
MIAMI RIVER BASIN
FAIRFIELD, OHIO
100-YEAR FLOOD LIMITS
NATURAL AND MODIFIED
FUTURE CONDITIONS
LOUISVILLE DISTRICT
CORPS OF ENGINEERS

AVENUE
PATRICIA DRIVE
DRIVE
STONE
DRIVE
SCALE IN FEET
400
0
400
800

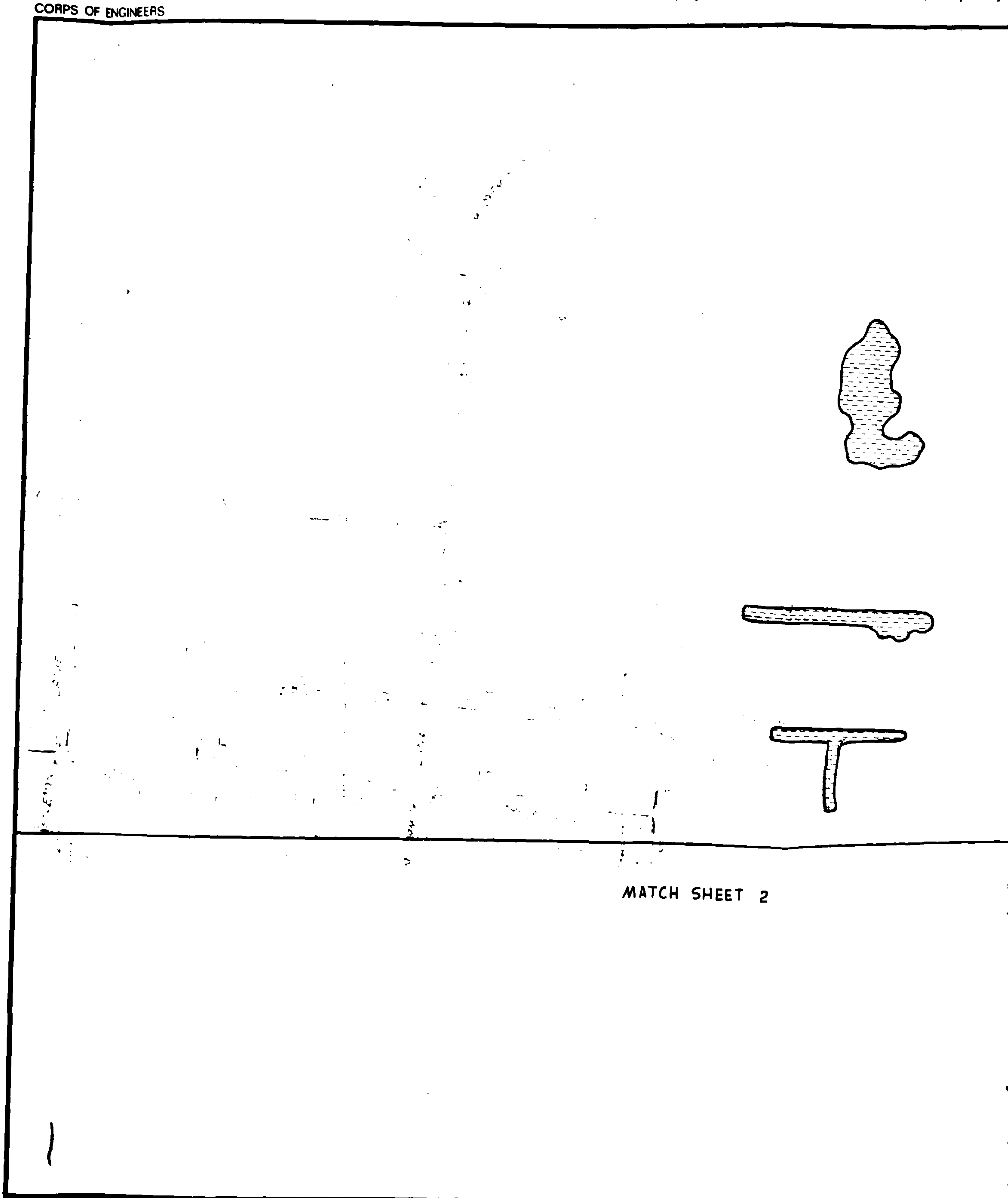


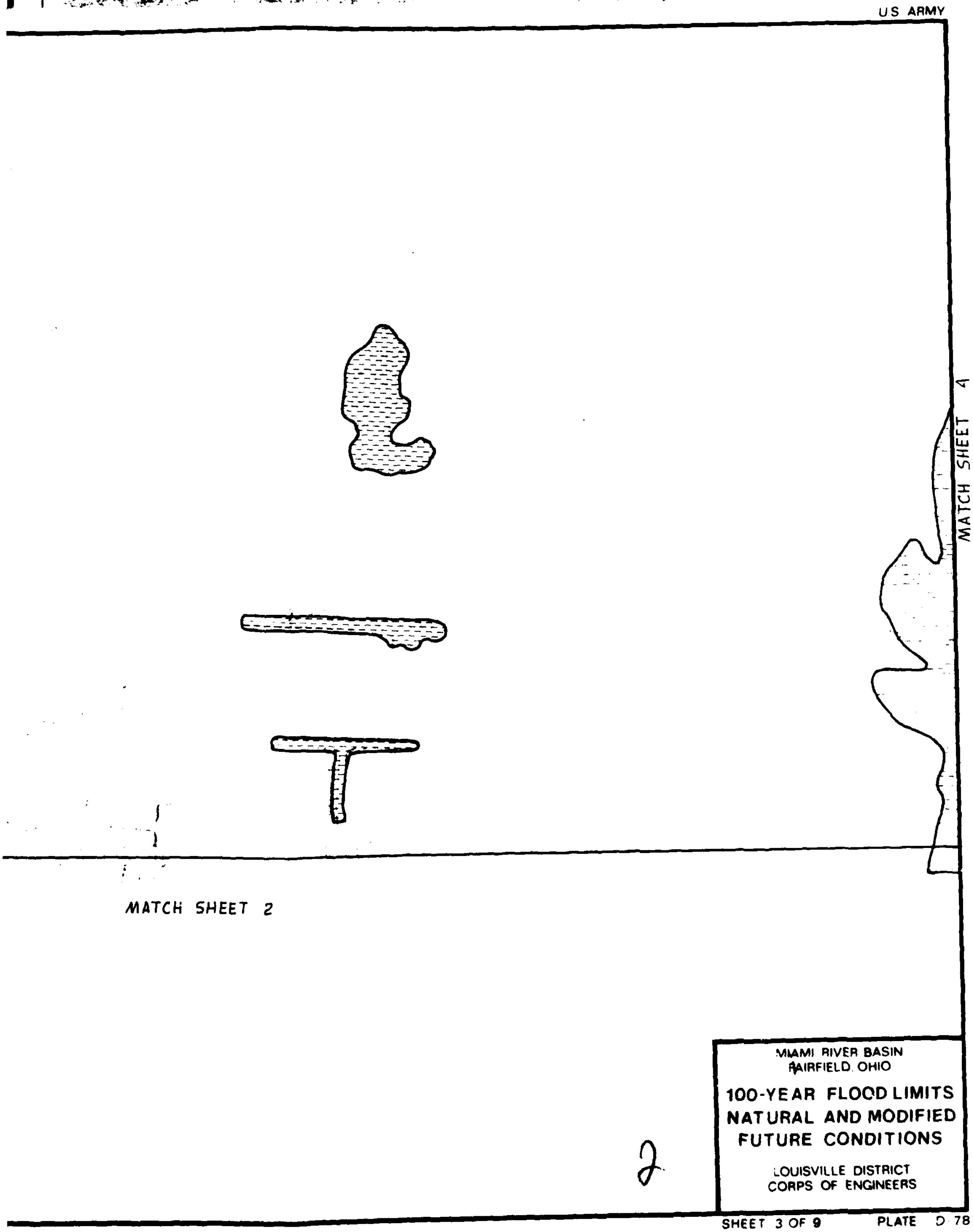
MIAMI RIVER BASIN
FAIRFIELD, OHIO

**100-YEAR FLOOD LIMITS
NATURAL AND MODIFIED
FUTURE CONDITIONS**

2 LOUISVILLE DISTRICT
CORPS OF ENGINEERS

CORPS OF ENGINEERS





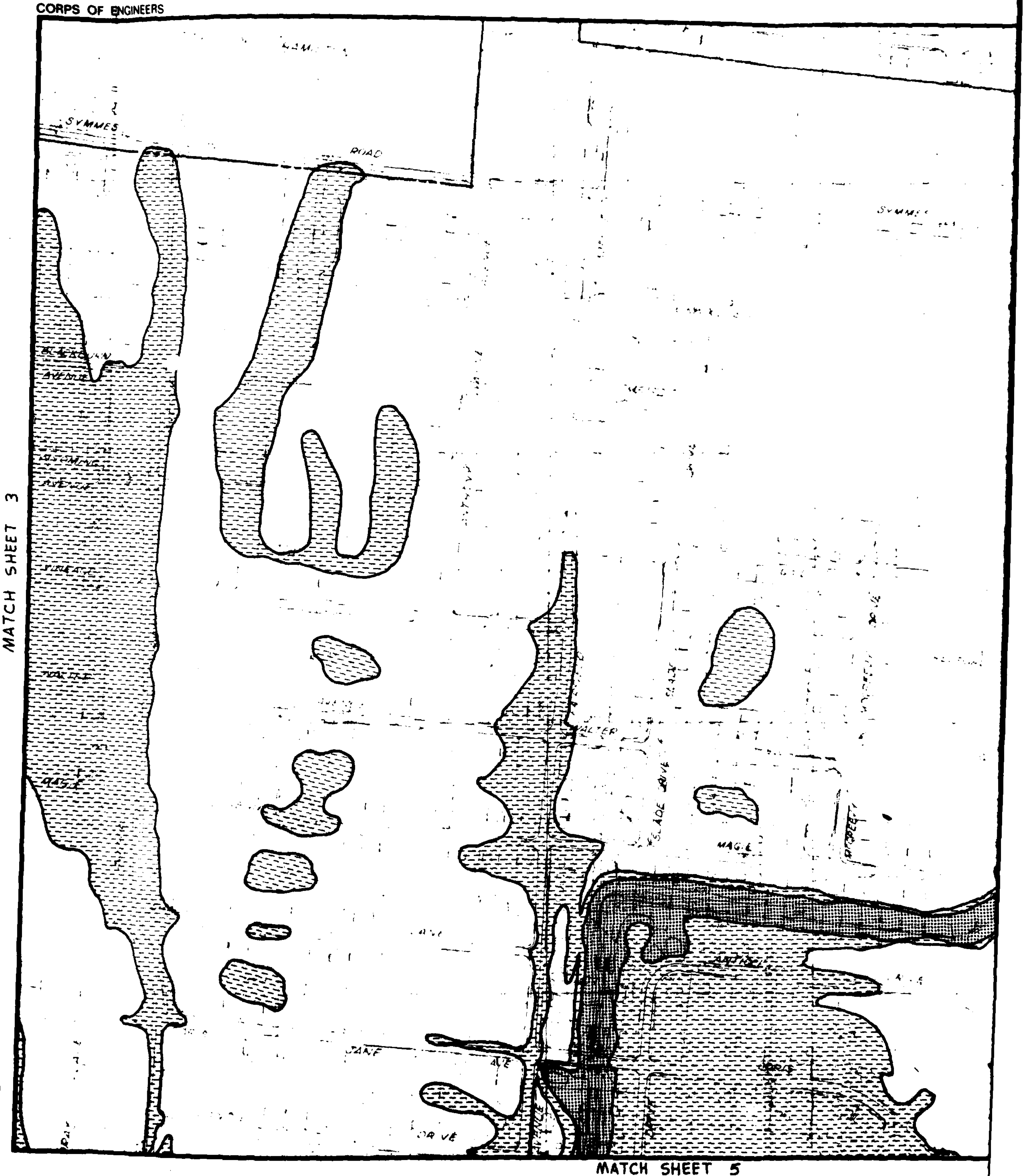
MIAMI RIVER BASIN
FAIRFIELD, OHIO

**100-YEAR FLOOD LIMITS
NATURAL AND MODIFIED
FUTURE CONDITIONS**

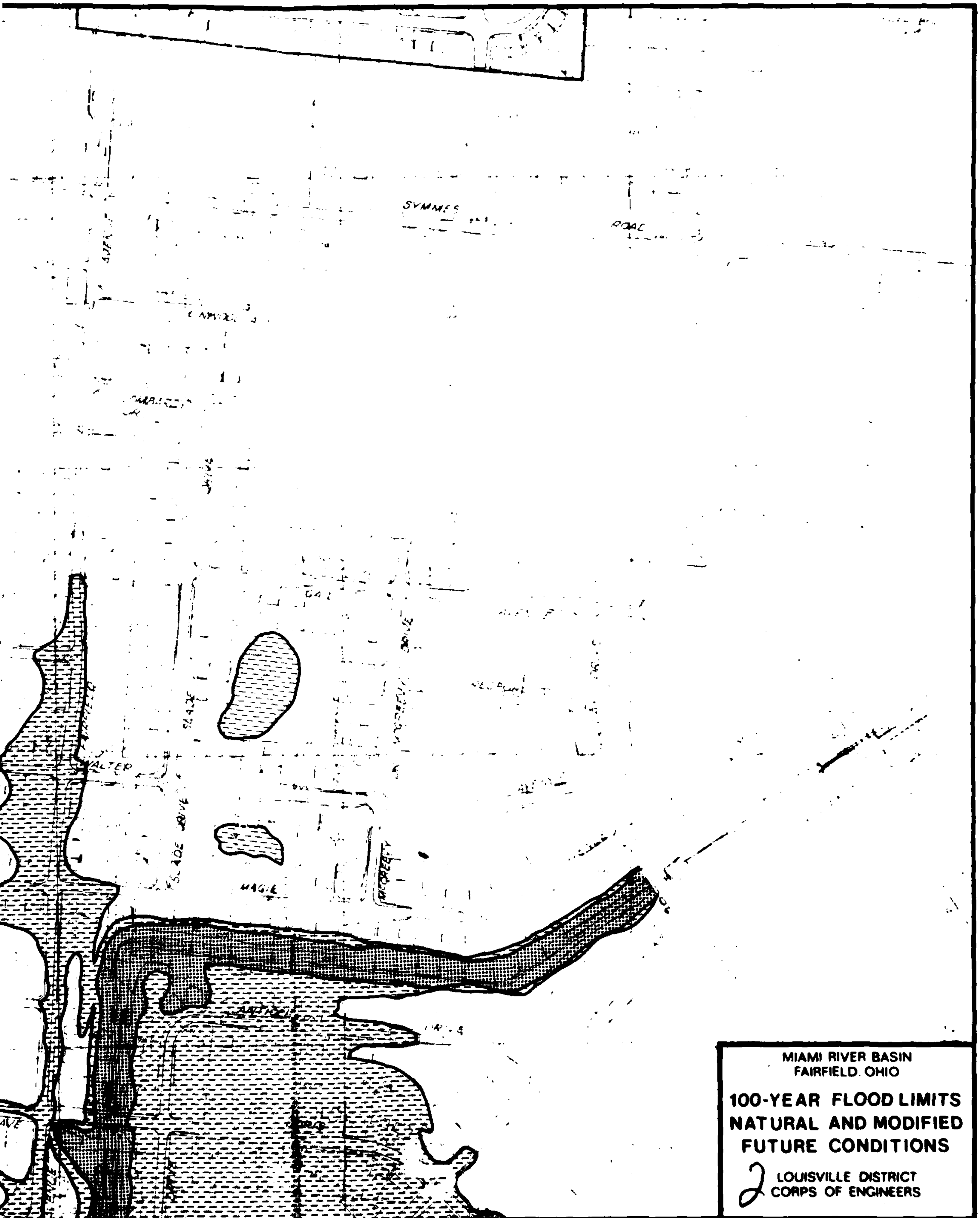
LOUISVILLE DISTRICT
CORPS OF ENGINEERS

SHEET 3 OF 9 PLATE D-78

CORPS OF ENGINEERS

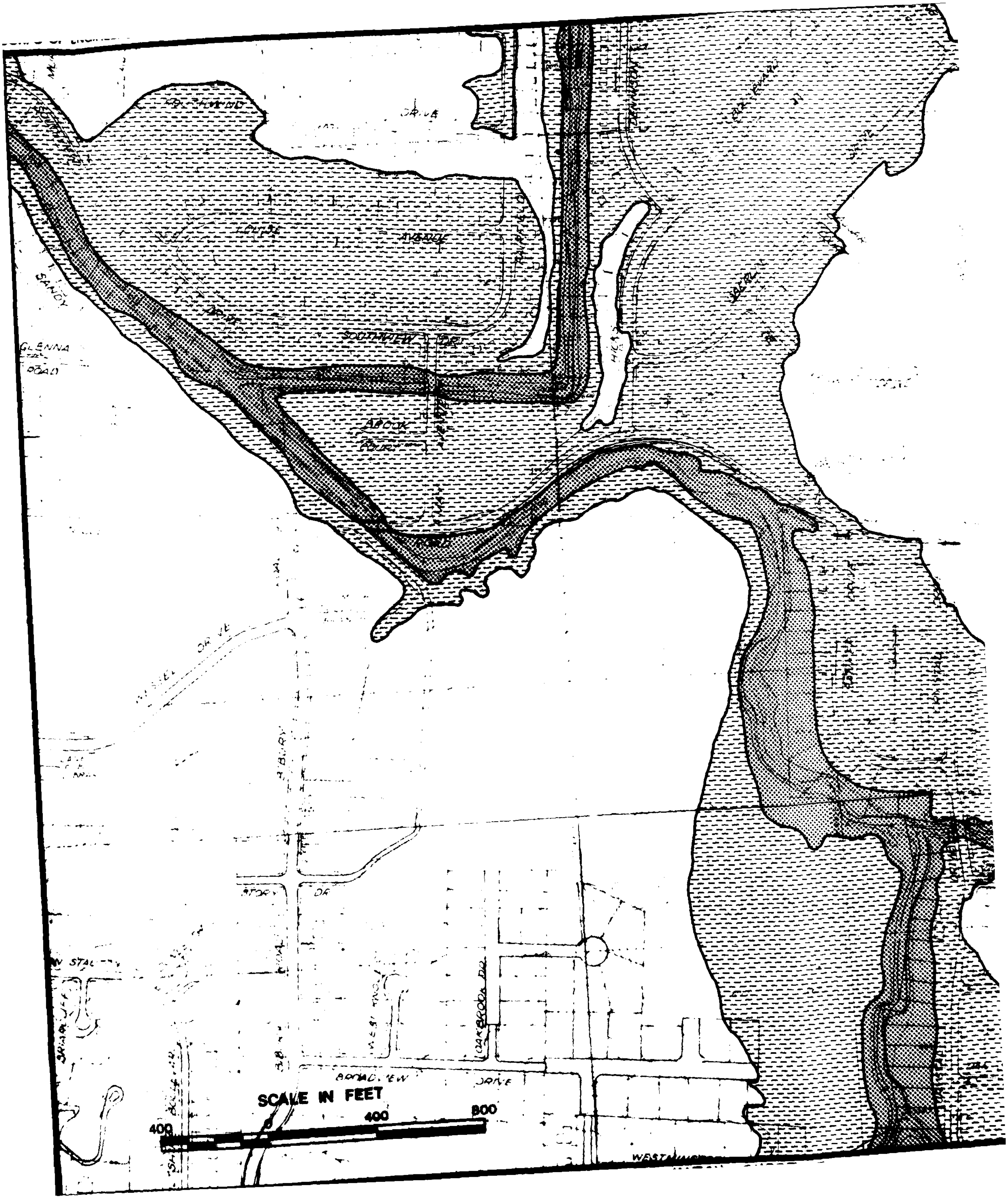


U.S. ARMY



MATCH SHEET 5

SHEET 4 OF 9 PLATE D-78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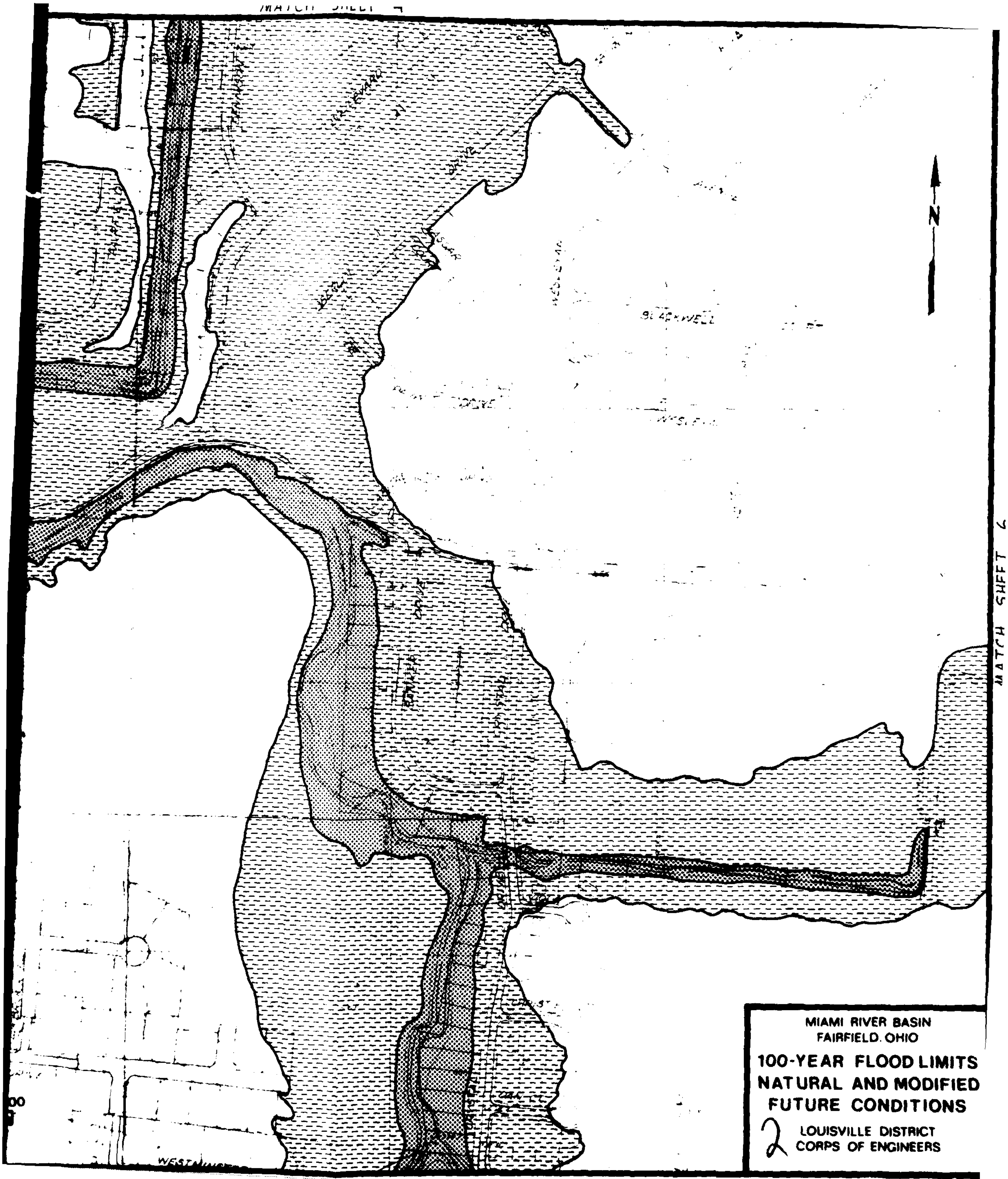
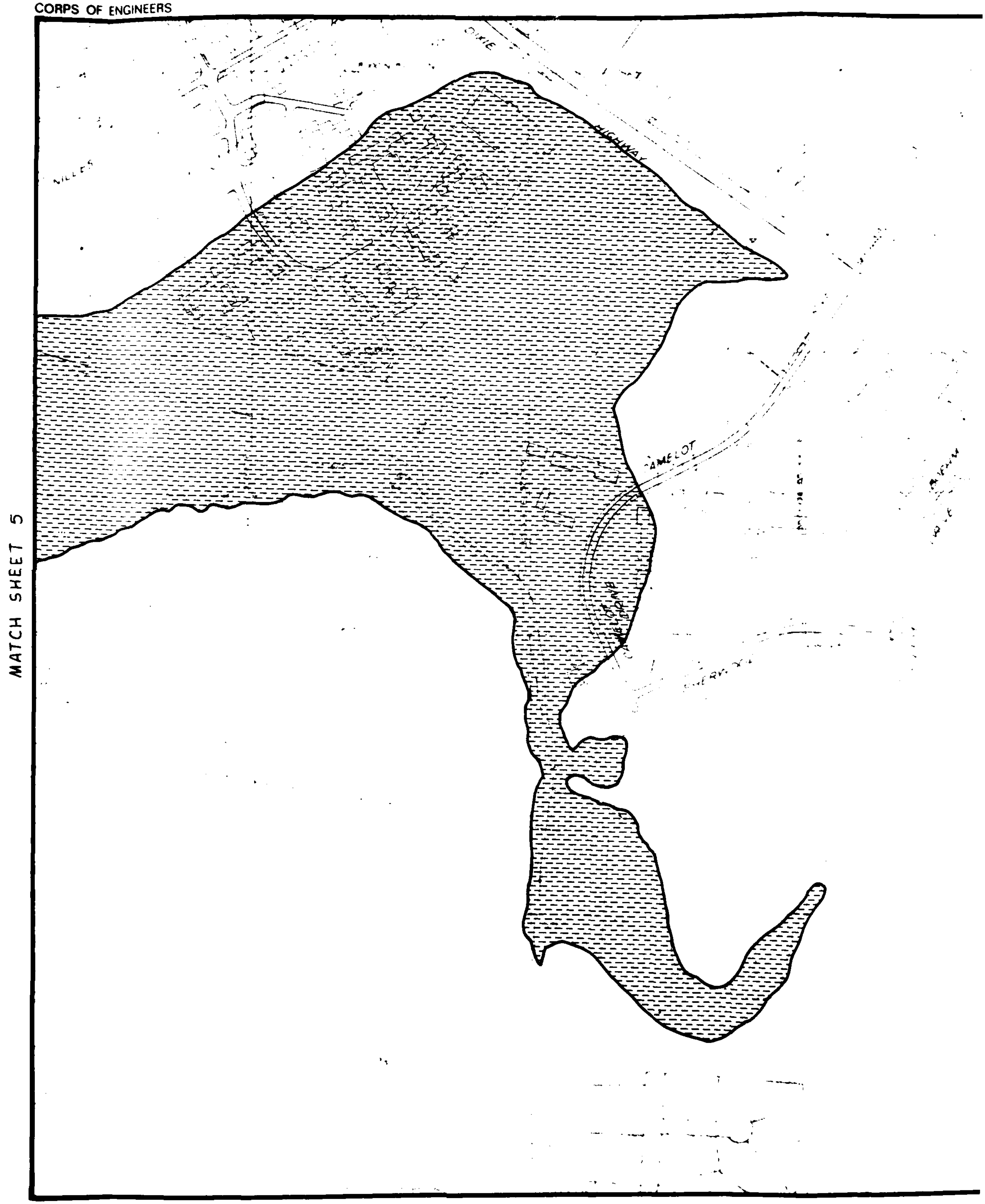
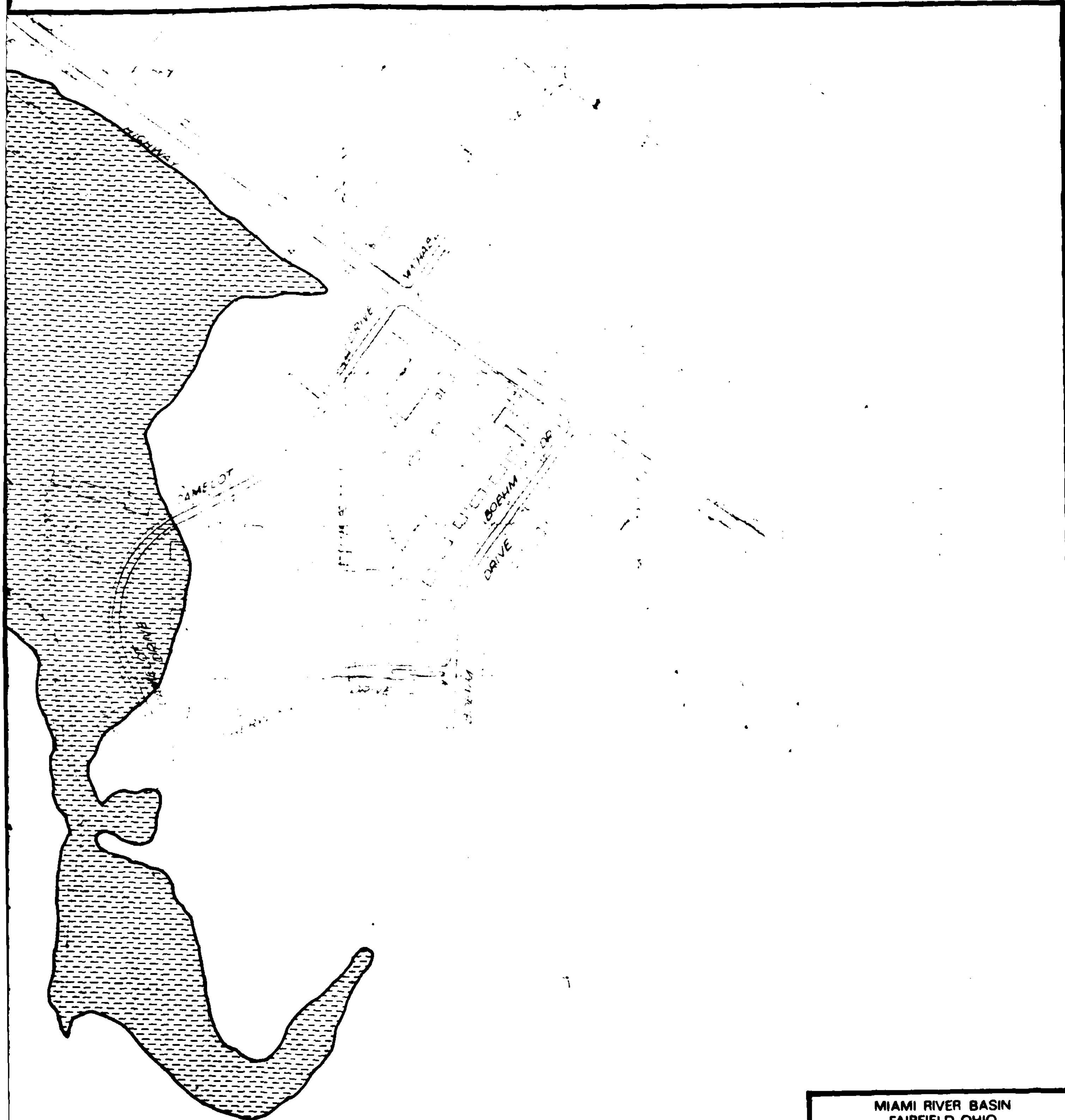


SHEET 5 OF 9 PLATE D-7

CORPS OF ENGINEERS

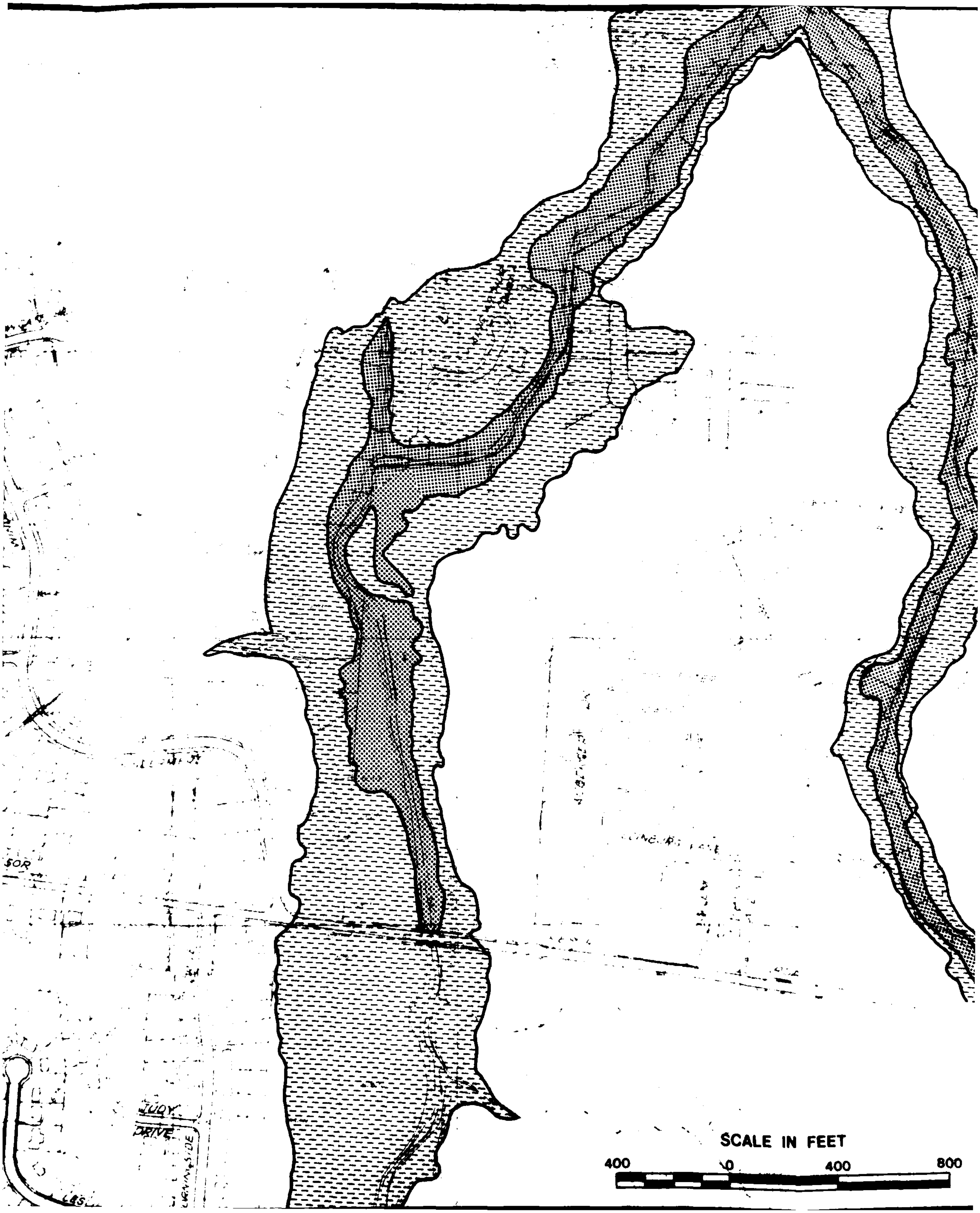




MIAMI RIVER BASIN
FAIRFIELD, OHIO

100-YEAR FLOOD LIMITS NATURAL AND MODIFIED FUTURE CONDITIONS

LOUISVILLE DISTRICT
CORPS OF ENGINEERS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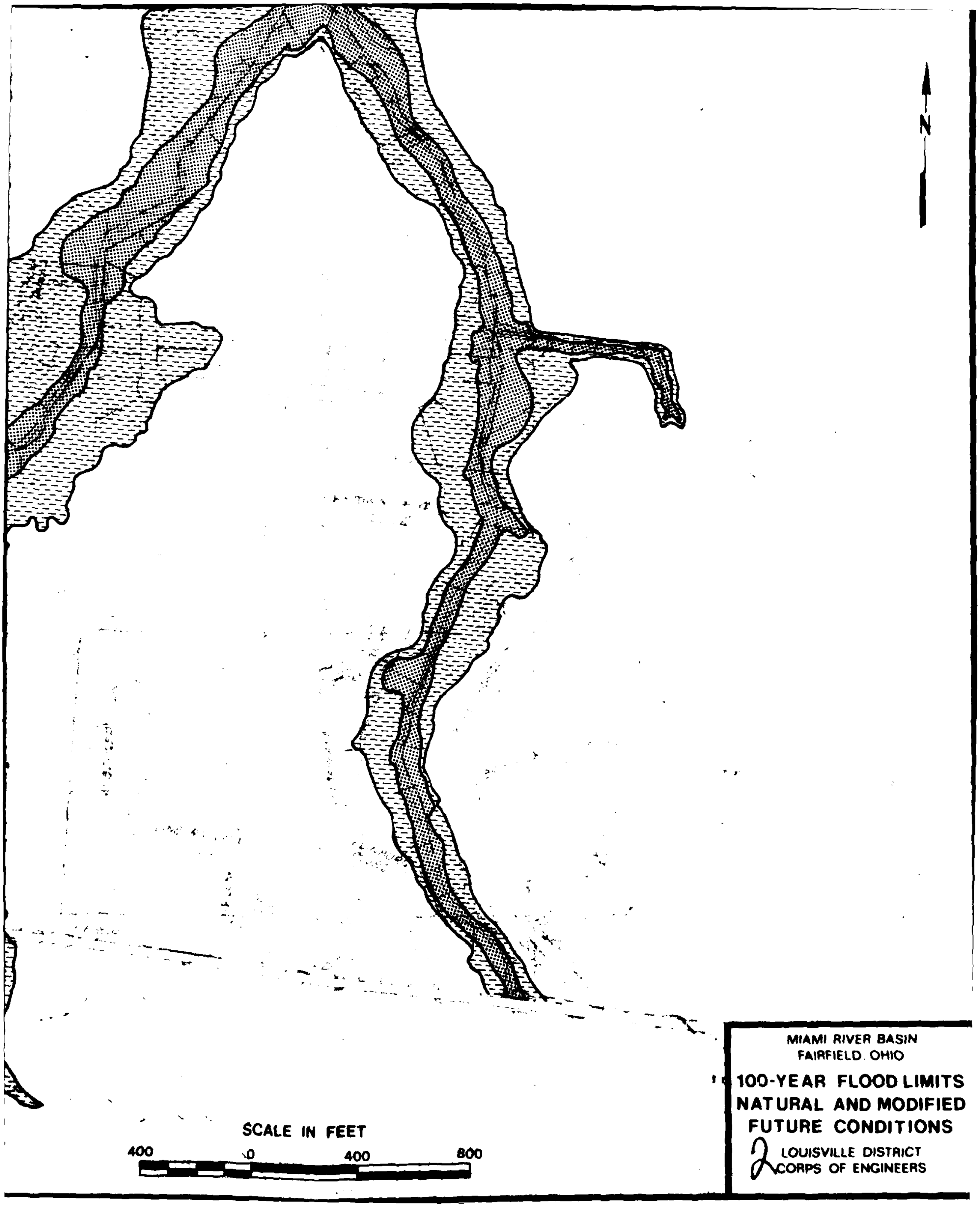
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MIAMI RIVER BASIN
FAIRFIELD, OHIO
100-YEAR FLOOD LIMITS
NATURAL AND MODIFIED
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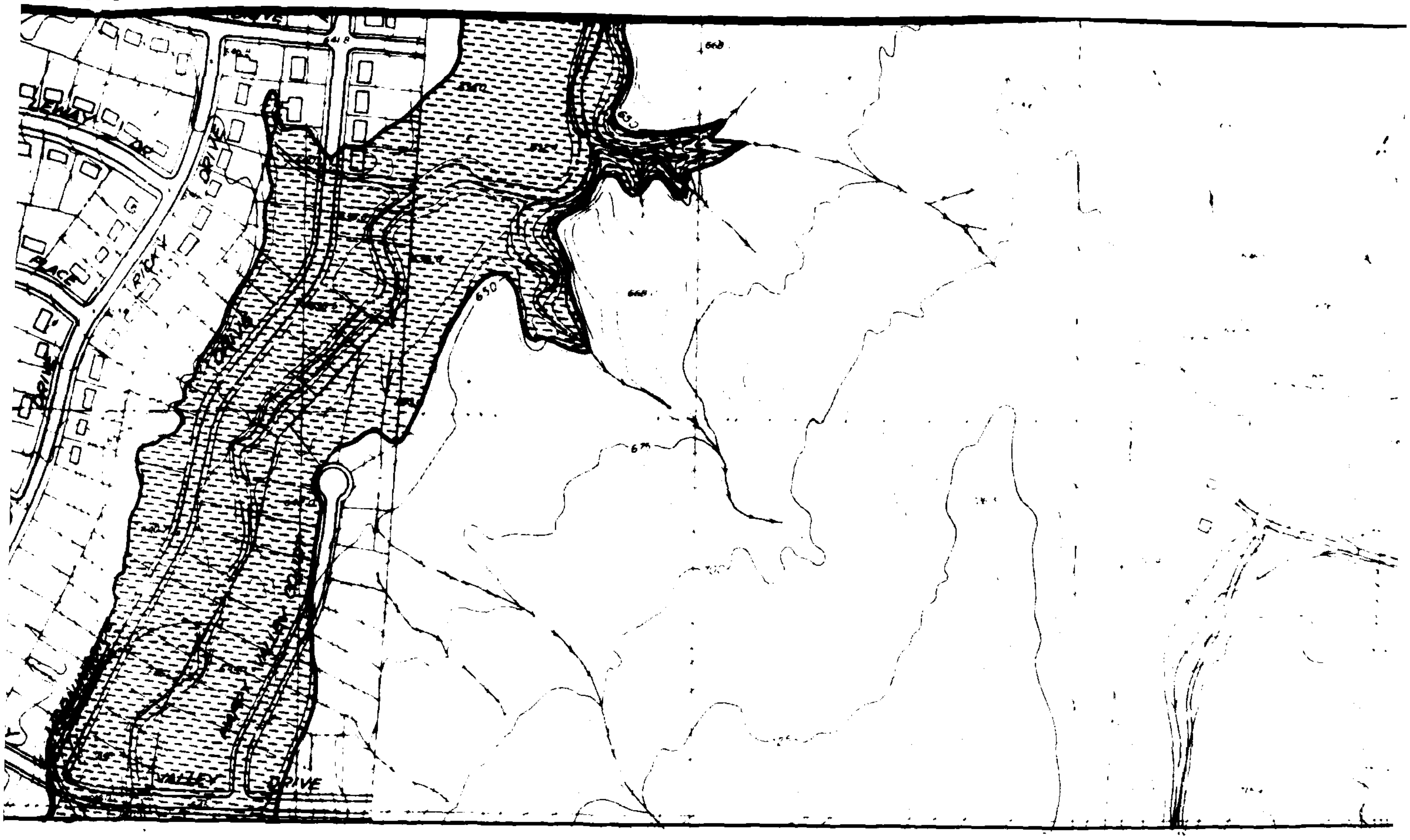
CORPS OF ENGINEERS



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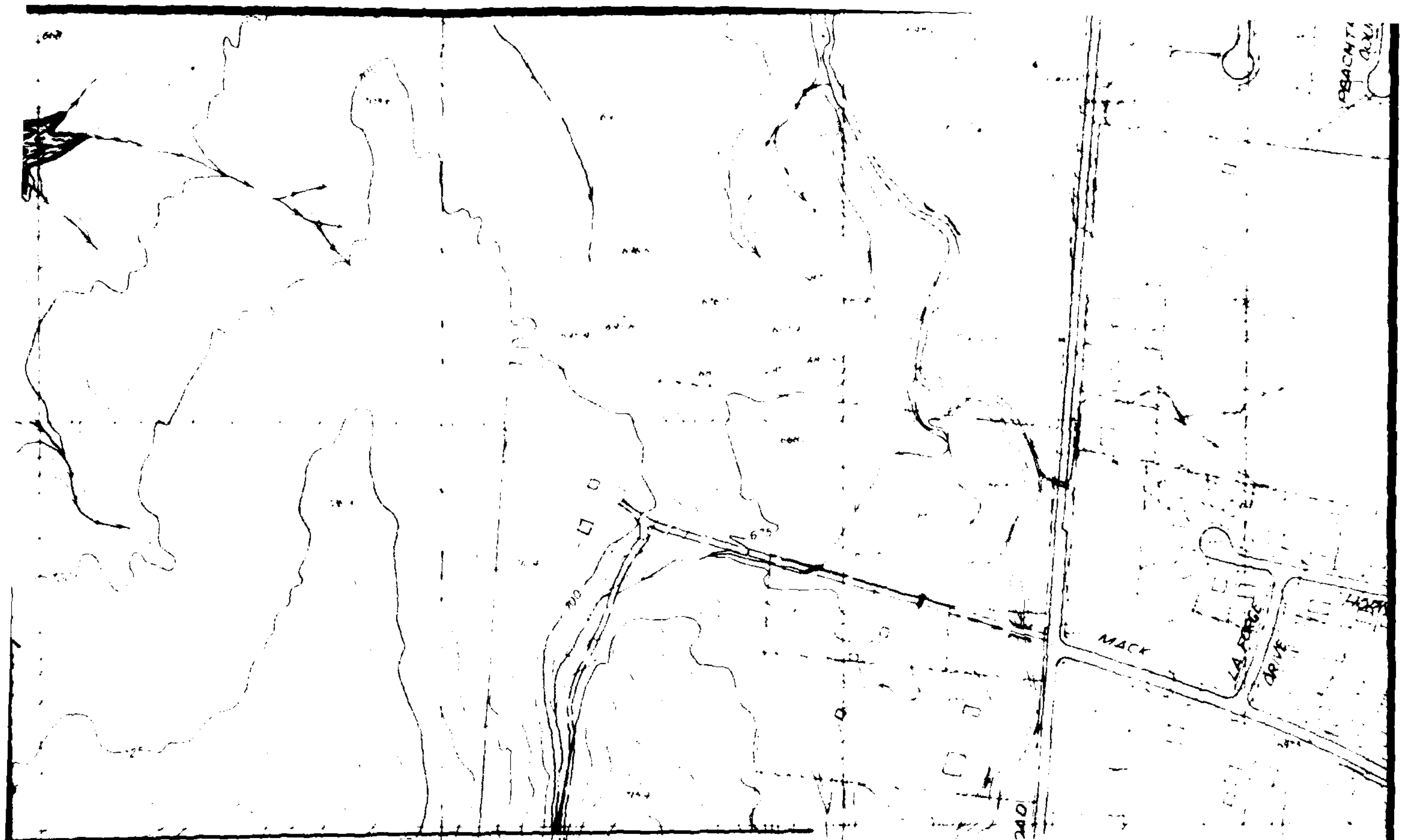

MATCH SHEET 9

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MIAMI RIVER BASIN
FAIRFIELD, OHIO

100-YEAR FLOOD LIMITS
NATURAL AND MODIFIED
FUTURE CONDITIONS

LOUISVILLE DISTRICT
CORPS OF ENGINEERS
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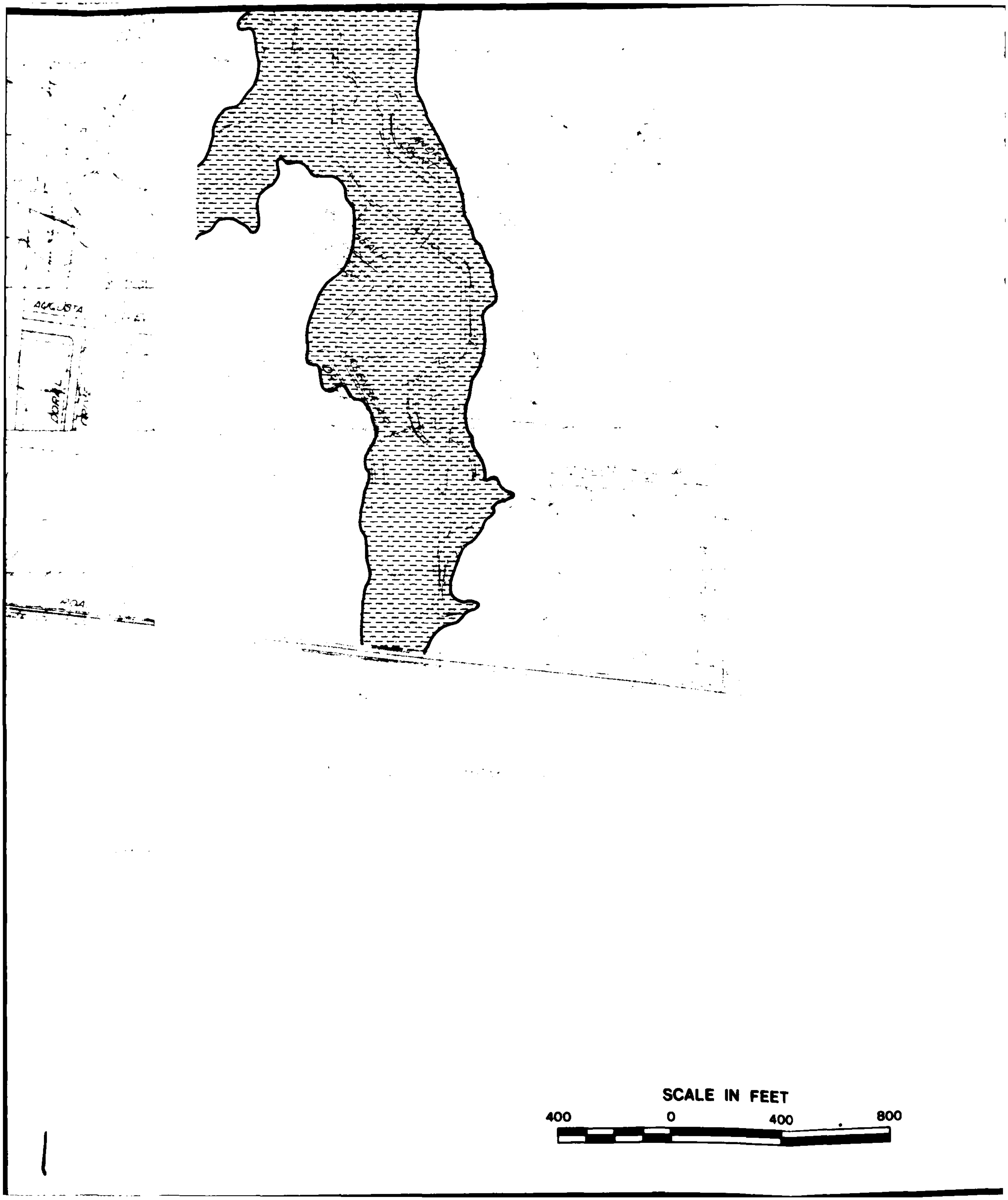

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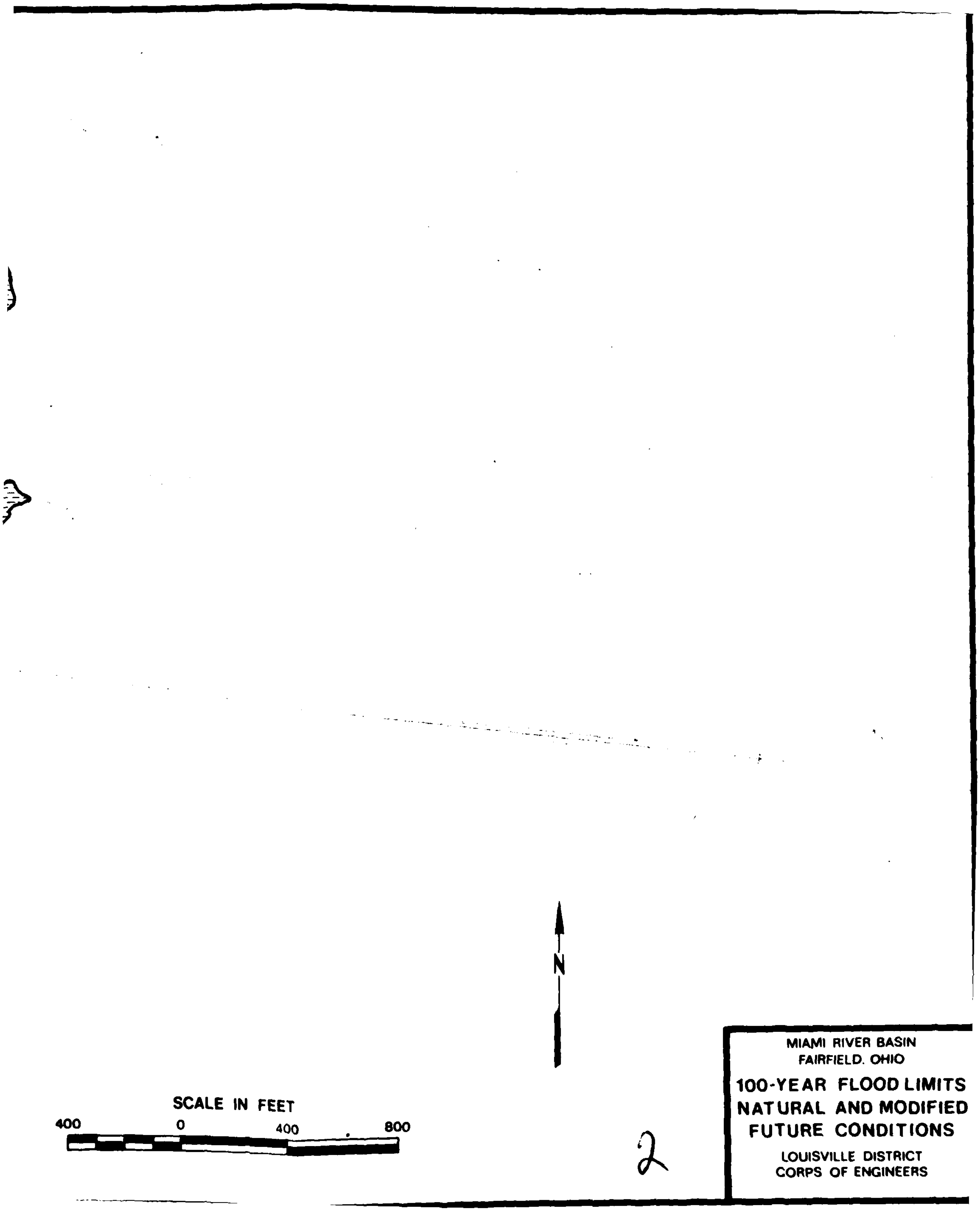
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MIAMI RIVER BASIN
FAIRFIELD, OHIO
100-YEAR FLOOD LIMITS
NATURAL AND MODIFIED
FUTURE CONDITIONS
LOUISVILLE DISTRICT
CORPS OF ENGINEERS

APPENDIX E
ECONOMICS

APPENDIX E
ECONOMICS

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APPENDIX E
ECONOMICS

This section provides the detailed economic data necessary for economic evaluation of the considered plans. The section proceeds from a general discussion of methodology to the detailed cost estimates, the derivation of annual economic charges, and the analysis of benefits. Final paragraphs summarize the data used for economic justification, perform tests for sensitivity, and discuss maximization of net benefits.

METHODOLOGY

The tangible economic feasibility of considered plans can be ascertained by comparing the equivalent average annual costs (including interest, amortization, operation and maintenance, and major replacements) with an estimate of the equivalent average annual benefits which would be realized over a selected economic life. Values given to costs and benefits at their time of accrual are made comparable by conversion to an equivalent time basis using an appropriate interest rate. The applicable interest rate used in the economic analysis for this report is 7-3/8 percent. Benefits were computed for the base year of 1987, which is assumed to be the earliest completion date for any considered plan.

COSTS

Quantities for the cost estimates were based on 2-foot contour mapping at a scale of 1" = 200', detailed utility locations, and numerous field notes and March 1980 cross sections of Pleasant Run Creek. Unit prices based on October 1980 values and conditions were obtained by a review of recent bid data for similar type projects. Real estate appraisers estimated the rights-of-way costs.

The largest cost items for the selected plan (the 3-dry bed reservoir plan plus channel enlargement in Reaches PR-3, 4 and 6 providing 100-year protection) are embankment, riprap, concrete for the spillway and walls and alteration to utilities for dry bed reservoirs A, C and D and channel excavation, gabions, riprap, concrete for the channel slope, and utility modifications or relocations for the channel enlargement in Reaches PR-3, 4 and 6.

Crushed limestone for riprap is available from local sources. The nearest approved source of natural aggregate is Symmes, Ohio, about 3 to 5 miles from Sites "A," "C" and "D." The riprap for the dry bed reservoirs is D_{50} = 16" for site "A" and D_{50} =17" for Sites "C" and D. Riprap is required on the channel bottom and side slopes of the impact basin and is 2.6' in thickness. Riprap for the channel improvement consists of a minimum size graded riprap of 25 pounds maximum size or 150 pounds quarry stone. Minimum thickness is 12" plus bedding or 18" without bedding.

Embankment for each of the 3-dry bed reservoirs is obtained from adjacent borrow areas. Borings taken at each site indicate that the material consists of silty to sandy clay and sands. The unit cost for the embankment reflects the availability of this material adjacent to each site.

Concrete for the dry bed reservoirs is based on that amount required for the spillway bottom and spillway walls. The ogee section of the spillway is assumed to be 20' wide x 5' deep and the spillway walls and bottom are considered to be 1.5' thick. Concrete for the channel consists of aproximately 1,200 L.F. of wall located upstream of Nilles Road Bridge in Reach PR-6.

Channel excavation is expected to encounter no rock and consist primarily of gravel, sand and silt deposits. The conclusions were based on surface and streambank observations while on several onsite inspections of the area. The material excavated from the channel will be disposed of in designated disposal areas located adjacent to the creek.

Approximately 2,200 L.F. of gabions are required on the left bank of Pleasant Run Creek between miles 0.94 and 1.34. Gabions are necessary because using riprap would require a flatter side slope thus causing destruction of valuable residential property.

Costs for the relocation or modification of the utilities were obtained from detailed costs furnished by the Miami Conservancy District.

A summary of the first costs for Plan H, I, J, and K as discussed in Appendix B is presented in Table E-1. These costs are based on October 1980 prevailing prices and include a contingency allowance of 20 percent. Engineering and design, and supervision and administration costs are based on percentage data taken from curves furnished with DAEN-CWE letter dated 11 January 1974. Detailed cost estimates for a considered 3-dry bed reservoir plan and considered channel improvement plans are presented in Tables E-2, E-3 and E-4. A summary of the first costs for the nonstructural plan is shown in Table E-5.

Costs for developing the recreation element are based on recent cost data for similar facilities. As the recreation development must be constructed on the lands acquired for the flood control plan and are dependent upon the desires and needs of the local sponsor, the exact type and quantity of facilities can only be estimated at this time. The selected plan consists of 3-dry bed reservoirs and 1.37 miles of channel widening. The recreation elements being considered for this plan consist of those elements for the dry bed reservoirs because of the large amount of land to be acquired for the temporary ponding and for borrow areas. No recreation has been considered along the channel due to the relative short length of channel work. The local sponsor favors a form of recreation for the dry bed reservoirs, but has not expressed a specific type at this time. The only recreation being considered along the channel are those facilties associated with Plan K, the 35-year all channel plan. Detailed costs for facilities and land is shown in Table E-6.

TABLE E-1

SUMMARY OF FIRST COSTS ($1,000)
Fairfield, Ohio

(October 1980 Prices)

Feature	Existing Cost Sharing			Proposed Cost Sharing 1/			
	Federal	Non-Federal	Total	Federal	Local	State	Total
Plan H - 35-Year, 3 Dry Bed Reservoirs, .83 Miles Channel Enlargement, Recreation							
Reservoirs	6,190	2,490	8,680	6,510	1,740	430	8,680
Channel	1,230	430	1,660	1,240	330	90	1,660
Total	7,420	2,920	10,340	7,750	2,070	520	10,340
Recreation	570	570	1,140	510	570	60	1,140
Total	7,990	3,490	11,480	8,260	2,640	580	11,480
Plan J - 100-Year, 3 Dry Bed Reservoirs 1.37 Miles Channel Enlargement, Recreation							
Reservoirs	6,190	2,490	8,680	6,510	1,740	430	8,680
Channel	2,070	1,150	3,220	2,410	650	160	3,220
Total	8,260	3,640	11,900	8,920	2,390	590	11,900
Recreation	570	570	1,140	510	570	60	1,140
Total	8,830	4,210	13,040	9,430	2,960	650	13,040
Plan I - 100-Year, 3 Dry Bed Reservoirs, Flood Proofing, Evacuation, Relocation, Recreation							
Reservoirs	6,190	2,490	8,680	6,510	1,740	430	8,680
Nonstructural 2/	6,290	1,670	7,960 3/	5,970	1,590	400	7,960
Total	12,480	4,160	16,640	12,480	3,330	830	16,640
Recreation	570	570	1,140	510	570	60	1,140
Total	13,050	4,730	17,780	12,990	3,900	890	17,780
Plan K - 35-Year 2.92 Miles Channel Enlargement, Recreation							
Channel	5,880	4,450	10,330	7,750	2,070	510	10,330
Recreation	195	195	390	175	195	20	390
Total	6,075	4,645	10,720	7,925	2,265	590	10,720

1/ Proposed by President in "Remarks of the President on Water Policy" dated 6 June 1978; proposal is for each of the following to pay a set percentage of the total project cost:

	Flood Control	Recreation
Federal	75%	45%
Local	20%	50%
State	5%	5%

2/ Existing cost sharing policy is 20% non-Federal and 80% Federal except for recreation features associated with evacuation and relocation where cost sharing is 50-50. See Table E-5.

3/ Cost includes $258,000 for recreation features as part of relocation and evacuation of structures.

TABLE E-2

DETAILED COST ESTIMATE 1/

Dry Bed Reservoirs A, C, D
Fairfield, Ohio

(October 1980 Prices)

Item	Unit	Unit Cost	Site A Quantity	Site A Total Cost	Site C Quantity	Site C Total Cost	Site D Quantity	Site D Total Cost
FEDERAL								
1. Clearing and Grubbing (Construction and Borrow Areas)	Acre	$2,000.00	15	$ 30,000	14	$ 28,000	26	$ 52,000
2. Stripping (Construction and Borrow Areas)	C.Y.	1.00	23,300	23,300	52,500	52,500	42,300	42,300
3. Inspection Trench, Excavation	C.Y.	5.00	4,000	20,000	3,100	15,500	2,700	13,500
4. Embankment	C.Y.	5.00	46,900	234,500	186,000	930,000	199,000	995,000
5. Access Road	Job	L.S.	1	7,900	1	1,000	1	6,000
6. Gravity Drainage Structure (48")	L.F.	75.00	186	13,950	300	22,500	360	27,500
7. Headwalls and Trash Racks	Job	L.S.	1	5,000	1	5,000	1	5,000
8. Material Disposal	C.Y.	0.20	31,700	6,300	69,500	13,900	46,300	9,300
9. Filter Material	C.Y.	20.00	1,900	38,000	2,330	46,600	2,030	40,400
10. Riprap	C.Y.	30.00	3,500	105,000	9,625	288,750	4,700	141,000
11. Bedding	C.Y.	20.00	1,350	27,000	3,780	75,600	1,750	35,000
12. Seeding and Fertilizing	Acre	1,500.00	16	24,000	37	55,500	26	39,000
13. Concrete for Spillway and Walls	C.Y.	250.00	907	226,800	570	142,500	571	142,750
14. Excavation, Channels	C.Y.	8.00	8,400	67,200	16,950	135,600	4,000	32,000
15. Contingencies (20%)				166,050		362,550		316,050
16. Subtotal				$ 995,000		$2,175,500		$1,896,300
17. Engineering and Design, Supervision and Inspection, and Overhead			23.5 Percent	234,000	22.0 Percent	478,500	22.1 Percent	418,700
18. TOTAL FEDERAL COST				$1,229,000 ($1,230,000)		$2,654,000 ($2,650,000)		$2,315,000 ($2,310,000)
NON-FEDERAL								
1. Lands and Damages 2/	Job	L.S.	1	$1,091,000	1	$ 250,000	1	$ 179,300
2. Utility Relocations	Job	L.S.	1	25,000	1	284,000	1	360,000
3. Contingencies (20%)				5,000		56,800		71,700
4. Subtotal				$1,121,000		$ 590,800		$ 611,000
5. Engineering and Design, Supervision and Inspection, and Overhead (20%)				6,000		67,200		86,000
6. TOTAL NON-FEDERAL COST				$1,127,000 (1,130,000)		$ 658,000 ($ 660,000)		$ 697,000 ($ 700,000)
TOTAL FEDERAL AND NON-FEDERAL COST				$2,356,000 ($2,360,000)		$3,312,000 ($3,310,000)		$3,012,000 ($3,010,000)

1/ First cost is based on existing cost sharing policies.
2/ Includes 25 percent contingencies, engineering and design, supervision and inspection, and overhead.

TABLE E-3

DETAILED COST ESTIMATE 1/

35-Year and 100-Year Channels
for the Considered 3 Dry Bed Reservoirs Plan
Fairfield, Ohio

(October 1980 Prices)

Item	Unit	Unit Cost	Quantity: 35-Year Channel Protection	Quantity: 100-Year Channel Protection	Cost: 35-Year Channel Protection	Cost: 100-Year Channel Protection
FEDERAL						
Clearing and Grubbing	Acre	$2,600.00	11	21	$ 27,500	$ 53,000
Channel Excavation	C.Y.	2.00	32,600	76,450	65,200	153,000
Spoil	C.Y.	1.00	39,100	91,760	39,100	92,000
Gabions	C.Y.	50.00	-	4,970	-	249,000
Riprap	C.Y.	21.00	7,700	12,330	161,850	259,000
Filter Cloth	S.Y.	4.00	17,625	28,630	70,500	115,000
Concrete	C.Y.	250.00	1,749	1,750	437,250	438,000
Seeding and Fertilizing	Acre	1,200.00	13	19	15,600	23,000
Landscaping	Job	L.S.	1	1	20,000	29,000
Low Flow Channel with Pools and Riffles	L.F.	3.60	4,383	7,551	15,800	27,000
Contingencies					170,600	285,000
Subtotal					$1,023,400	$1,723,000
Engineering and Design, Supervision and Inspection, and Overhead			19.9 Percent	21 Percent	203,600	348,000
Total Federal Cost					$1,227,000 ($1,230,000)	$2,071,000 ($2,070,000)
NON-FEDERAL						
Lands and Damages 2/	Job	L.S.	1	1	385,000	626,000
Mitigation Lands 2/	Acre	5,000	5	5	25,000	25,000
Utility Relocation	Job	L.S.	1	1	18,700	209,000
Replace East River Rd Bridge	S.F.	60.00	-	2,700	-	162,000
Contingencies					3,700	45,000
Subtotal					$ 432,400	$1,067,000
Engineering and Design Supervision and Inspection, and Overhead			20 Percent	20 Percent	4,600	84,000
Total Non-Federal Cost					$ 437,000 ($ 430,000)	$1,151,000 ($1,150,000)
TOTAL PROJECT COST					$1,664,000 ($1,660,000)	$3,222,000 ($3,220,000)

1/ First cost is based on existing cost sharing policies.
2/ Incl[illegible]e 25 percent contingencies, engineering and design, supervision and inspection, and overhead.

Plan K - 35-Year All-Channel Plan
(2.92 Miles of Channel Widening
in Reaches PR-2, 3, 4, 5, 6)
Fairfield, Ohio

(October 1980 Prices)

Item	Unit	Unit Cost	Quantity	Cost
FEDERAL				
Clearing and Grubbing	Acre	$2,500.00	86	$ 215,000
Channel Excavation	C.Y.	2.00	505,000	1,010,000
Material Disposal	C.Y.	1.00	585,000	585,000
Riprap	C.Y.	21.00	50,700	1,065,000
Filter Cloth	S.Y.	4.00	94,000	376,000
Concrete Channel	C.Y.	250.00	2,800	700,000
Landscaping	Job	L.S.	1	120,000
Seeding and Fertilizing	Acre	1,200.00	76	91,200
Low Flow Channel with Pools and Riffles	L.F.	3.60	13,500	48,600
Contingencies (20%)				802,000
Subtotal				$ 5,013,000
Engineering and Design, Supervision and Inspection, and Overhead				865,000
Total Federal Cost				$ 5,878,000 ($5,880,000)
NON-FEDERAL				
Lands and Damages 2/	Job	L.S.	1	$ 1,956,000
Mitigation Lands 2/	Acre	$5,000	5	25,000
Bridge Replacement				
River Road	S.F.	60.00	4,110	246,600
Pleasant Run	S.F.	60.00	2,400	144,000
Nilles Road	S.F.	60.00	12,000	720,000
Utilities Relocation	Job	L.S.	1	608,500
Contingencies (20%)				343,000
Subtotal				$ 4,043,100
Engineering and Design Supervision and Inspection, and Overhead				410,900
Total Non-Federal Cost				$ 4,454,000 ($ 4,450,000)
TOTAL PROJECT COST				$10,332,000 ($10,330,000)

1/ First cost is based on existing cost sharing policies.
2/ Includes 25 percent contingencies, engineering and design, supervision and inspection, and overhead.

TABLE E-5 1/

DETAILED COST ESTIMATE

Nonstructural Measures to Provide 100-Year
Protection When Used with Dry Bed
Reservoirs A, C, and D

Item	Unit	Unit Cost	Quantity	Total Cost
Evacuation	Each	71,300	35	$2,495,500
Relocation	Each	56,500	14	791,000
Flood Proofing				
Structures Only	Each	8,500	18	153,000
Combinations	Each	13,500	67	904,500
Basements Only	Each	6,000	176	1,056,000
Other	Each	3,000	30	90,000
Contingencies (15%)				826,000
Subtotal				6,316,000
E&D, S&A, Overhead (22%)				1,389,000
TOTAL				$7,705,000

Federal = .80 x $7,705,000 = $6,164,000

Non-Federal = .20 x $7,705,000 = $1,541,000

Recreation features associated with Evacuation and Relocation of structures has been estimated to be $258,000.

Federal Cost = $258,000 x .50 = $129,000 for recreation

Non-Federal Cost = $258,000 x .50 = 129,000 for recreation

Total Nonstructural Cost = $6,293,000 Federal

$1,670,000 Non-Federal

1/ First cost is based on existing cost sharing policies

TABLE E-6

DETAILED COST ESTIMATE 1/ 2/

Recreation Plan for Dry Bed Reservoir Sites A, C, D
and All-Channel Plan (Reaches PR-2, 3, 4, 5, 6)

(October 1980 Prices)

Item	Unit	Unit Price	Quantity Site A	Quantity Site C	Quantity Site D	All Channel	Total Cost Site A	Total Cost Site C	Total Cost Site D	Total Cost Dry Bed Reservoirs	All Channel
Roads and Parking	S.Y.	$ 25.00	1,000	5,000	1,000	--	$ 25,000	$125,000	$ 25,000	$ 75,000	
Jogging/Walking Trails	L.F.	5.00	11,000	5,500	5,300	--	55,000	27,500	26,500	109,000	
Biking Trails	L.F.	10.00	6,100	5,400	5,800	16,000	61,000	54,000	58,000	173,000	160,000
Tot Lot	Job	L.S.	1	1	1	--	3,500	3,500	4,000	11,000	
Grading and Seeding	Acre	500.00	--	8	4	--	--	4,000	2,000	6,000	
Picnic Facilities	Each	500.00	--	40	--	--	--	20,000	--	30,000	
Shelter	Job	L.S.	--	1	--	--	--	20,000	--	20,000	
Bicycle and Foot Bridge	Job	L.S.	--	--	--	1	--	--	--	--	100,000
Park Furniture	Job	L.S.	--	--	1	--	--	--	10,000	--	
Tree Pruning and Landscaping	Job	L.S.	1	1	1	--	10,000	10,000	8,000	28,000	
Utility Connections	Job	L.S.	--	1	--	--	--	20,000	--	20,000	
Restrooms	Job	L.S.	--	1	--	--	--	65,000	--	65,000	
Maintenance Building	Job	L.S.	--	1	--	--	--	90,000	--	90,000	--
Contingencies (25%)							38,500	111,000	33,500	183,000	65,000
Subtotal							$193,000	$550,000	$167,000	$ 910,000	$325,000
Engineering and Design, Supervision and Inspection and Overhead (20%)							39,000	112,000	34,000	185,000	65,000
Estimated Total Cost for Facilities							$232,000	$662,000	$201,000	$1,095,000	$390,000
Lands and Damages	Job	L.S.	1	1	1	--	25,000	10,000	10,000	45,000	--
Estimated Total Cost for Facilities and Lands							$257,000	$672,000	$211,000	$1,140,000	$390,000

1/ Facilities shown could change as the results of rights-of-way acquired for the flood control plan and desires of the local sponsor.
2/ Total cost to be shared 50-50 by Federal and non-Federal under existing cost sharing policy.

ANNUAL COSTS

Annual costs are obtained by spreading the first costs over the economic life of the project and adding estimated annual costs for operation and maintenance and major replacements. This is done by multiplying the first costs by the interest and amortization factor of 7-3/8 percent for 50 periods. Annual costs for operation and maintenance, and major replacements are estimated from historical data for similar projects.

Economic and financial annual costs Plans H, I, J, and K are shown in Table E-7. Both flood control and recreation annual costs are shown.

FLOOD DAMAGES

The following paragraphs discuss evaluation of various items related to flooding. These items include physical and nonphysical damages, emergency costs, and costs associated with administration of flood insurance.

The Pleasant Run flood plain study area, although primarily residential, also includes commercial, public, transportation and utility properties. For evaluation purposes, the study area was divided into numerous conventional stream reaches and special overbank and ponding areas. These stream reaches and areas are shown generally on Plate E-1. The boundaries of the special overbank and ponding areas evaluated are delineated on elevation frequency curves shown in the Appendix D - Hydrology and Hydraulics.

PHYSICAL FLOOD DAMAGES

Physical damage estimates and evaluations in this report are based on updates of data from surveys conducted by AE contract (Vogt-Ivers and Associates) in 1975 and by the Louisville District in 1977 through 1980. These surveys included determination of damageable elevations, appraisal of property values, and estimates of damages for recurrence of

TABLE E-7

SUMMARY OF ESTIMATED ANNUAL COSTS ($1,000)
FAIRFIELD, OHIO

(October 1980 Prices)

	Plan H			Plan J			Plan I			Plan K		
	Flood Control	Recreation	Total	Flood Control	Recreation	Total	Flood Control	Recreation	Total	Flood Control	Recreation	Total
First Cost	10,330	1,140	11,470	11,900	1,140	13,040	16,640	1,140	17,780	10,330	390	10,720
Interest During Construction 1/	1,144	126	1,270	1,314	126	1,440	1,834	126	1,960	1,137	43	1,180
Total Investment	11,474	1,266	12,740	13,214	1,266	14,480	18,474	1,266	19,740	11,467	433	11,900
Salvage Value 2/	37	1	38	44	1	45	28	1	29	43	0	43
Net Investment	11,437	1,265	12,702	13,170	1,265	14,435	18,446	1,265	19,711	11,424	423	11,857
Interest 3/	843	93	936	972	93	1,065	1,360	93	1,453	843	31	874
Amortization 3/	25	3	28	29	3	32	40	3	43	25	1	26
Operation & Maintenance 4/	22	77	99	33	77	110	19	77	96	46	30	76
Major Replacement 5/	3	14	17	3	14	17	8	17	25	0	5	5
Land Productivity 6/	16	1	17	19	1	20	12	1	13	19	0	19
Total (Econ)	909	188	1,097	1,056	188	1,244	1,439	191	1,630	933	67	1,000
Financial Only 7/			1,080			1,222			1,617			981

1/ Interest during construction based on 50% cost each year, 2-year construction period,
First cost x [(0.5) (.07375) (2 yr) + (.5) (.07375) (1 yr)] = FC (.1107).
2/ Salvage value = 80% x land value x .0285 [Total LV = 1,616 for (H)] [1,942 for (J)], [1,208 for (I)] [1,891 for (K)]
3/ 7-3/8% at 50 years: I = .07375, A = .0022.
4/ Recreation O&M = $0.30/rda x rda. rda = (H) 255,000, (J) 255,000, (I) 300,000, and (K) 100,000.
5/ Recreation MR = .0128 x Recreation Facility Cost. RFC = (H) 1,095, (J) 1,095, (I) 1,353, and (K) 390.
6/ 1% x Land Value in footnote 2/.
7/ Financial Costs = Economic Costs minus loss in land productivity.

various flood heights. Realtors were contacted, and residential and business occupants were interviewed during the surveys. Information thus obtained and supplemented by experience of the surveyors was used as a basis of property value estimates. Indices published by Engineering News Record (ENR) were used to update these estimates to current values. Residential elevation data were related to flood profiles at the synthetic gages to determine depths of flooding. Flooding depths were then related to the depth-damage factors shown in Table E- . These factors were derived during prior Miami River Basin studies. These factors represent damage as percent of residential structure and content values for various structure types. Damages to residential property from recurrence of various flood heights were estimated by this method. The validity of the Miami River Basin depth-damage factors was verified during a recent detailed study of damages from a maximum record flood during December 1978 in Frankfort, Kentucky. Physical damages to other property categories in the Pleasant Run study area from various flood heights were determined by ENR update of estimates obtained by interview during the surveys.

Table E-9 shows area, unit, value and physical damage estimates by property category and reach from recurrence of various flood heights based on existing land use and natural flood profiles. The following paragraphs describe the physical damage items for the property categories shown in this table.

TABLE E-8

RESIDENTIAL PHYSICAL DAMAGE IN PERCENT OF STRUCTURE AND CONTENT VALUE
PLEASANT RUN AND TRIBUTARIES
FAIRFIELD, OHIO

Depth in Feet	Percent Damage 1 Story: Structure With and Without Base	1 Story Structure: BASEMENT	Percent Damage 1 Story: Contents With and Without Base	1 Story Contents: BASEMENT	Percent Damage 1-1/2 to 2 Stories: Structure With and Without Base	1-1/2 to 2 Stories Structure: BASEMENT	Percent Damage 1-1/2 to 2 Stories: Contents With and Without Base	1-1/2 to 2 Stories Contents: BASEMENT	Percent Damage Mobile Homes: Real Property	Percent Damage Mobile Homes: Contents
8	39.0		80.0		30.0		47.0		88.0	83.0
7	37.0		78.0		29.0		46.0		83.0	82.0
6	35.0		76.0		28.0		45.0		76.0	78.0
5	33.0		72.0		26.0		42.0		65.0	73.0
4	30.0		66.0		24.0		38.0		52.0	67.0
3	27.0		56.0		22.0		34.0		38.0	57.0
2	24.0		45.0		18.0		27.0		25.0	37.0
1	19.0		35.0		14.0		18.0		13.0	17.0
EVEN 0	4.0	12.0	0	24.0	4.0	10.0	0	13.0	3.0	0
BASEMENT 7	2.0	8.0		17.0	2.0	7.0		9.0	2.0	
BASEMENT 6	0	7.0		12.0	0	6.0		6.0	0	
BASEMENT 5		5.0		8.0		5.0		4.0		
BASEMENT 4		4.0		6.0		4.0		3.0		
BASEMENT 3		3.0		4.0		3.0		2.0		
BASEMENT 2		2.0		2.0		2.0		2.0		
BASEMENT 1		1.0		1.0		1.0		1.0		
BASEMENT 0		0		0		0		0		

TABLE E-9

AREA, UNIT, VALUE, AND PHYSICAL DAMAGES FROM
RECURRENCE OF VARIOUS FLOOD HEIGHTS
1980 DEVELOPMENT AND 1995 NATURAL HYDROLOGIC CONDITIONS
PLEASANT RUN AND TRIBUTARIES, FAIRFIELD, OHIO
(October 1980 Price Levels)

Stream Reach and Category	Flood Height			
	SPF	500-Yr	100-Yr	25-Yr
Pleasant Run				
Reach PR-2				
Area in Acres	60	40	25	22
Number Units Residential	42	34	31	27
Property Value ($1,000)				
Residential 1/	3,720	3,012	2,739	2,393
Transportation	500	400	340	250
Utility	88	85	78	70
Total Value	4,308	3,497	3,157	2,713
Damage ($1,000)				
Residential	118.9	105.7	100.2	92.0
Transportation	4.8	4.1	3.4	2.7
Utility	2.9	2.8	2.5	2.1
Total Damage	126.6	112.6	106.1	96.8
Reach PR-3				
Area in Acres	118	111	106	102
Number Units Residential	172	154	132	110
Property Value ($1,000)				
Residential 1/	13,233	11,850	10,160	8,463
Transportation	1,850	1,800	1,500	1,005
Utility	465	420	360	297
Total Value	15,548	14,070	12,020	9,765
Damage ($1,000)				
Residential	876.2	786.2	670.1	594.6
Transportation	319.2	250.2	165.3	115.9
Utility	12.7	8.4	11.8	14.4
Total Damage	1,208.1	1,044.8	847.2	724.9

TABLE E-9 (Continued)

Stream Reach and Category	Flood Height SPF	500-Yr	100-Yr	25-Yr
Reach PR-3A				
Area in Acres	22	21	20	19
Number Units Residential	41	38	36	32
Property Value ($1,000)				
Residential 1/	3,125	2,895	2,750	2,436
Transportation	270	260	250	175
Utility	85	80	75	65
Total Value	3,480	3,235	3,075	2,675
Damage ($1,000)				
Residential	290.0	288.9	284.4	239.3
Transportation	24.0	23.2	22.6	16.9
Utility	5.0	4.0	3.7	2.9
Total Damage	319.0	316.1	310.7	259.1
Reach PR-4A & 4B				
Area in Acres	76	74	70	66
Number Units Residential 2/	40	40	40	40
Commercial	14	14	11	9
Total Units	54	54	51	49
Property Value ($1,000)				
Residential 1/	1,850	1,850	1,850	1,850
Commercial 1/	3,600	3,600	2,820	2,295
Transportation	Nil	Nil	Nil	Nil
Utility	4,125	4,125	4,120	4,112
Total Value	9,575	9,575	8,790	8,257
Damage ($1,000)				
Residential	796.0	794.1	787.4	780.7
Commercial	101.0	100.0	99.9	48.4
Transportation	Nil	Nil	Nil	Nil
Utility	0.9	0.9	0.8	0.7
Total Damage	897.9	895.0	888.1	829.8

TABLE E-9 (Continued)

Stream Reach and Category	Flood Height SPF	500-Yr	100-Yr	25-Yr
Reach PR-5 (LB Ponding)				
Area in Acres	25	20	17	10
Number Units Residential	36	26	24	13
Commercial	28	22	18	13
Total Units	64	48	42	26
Property Value ($1,000)				
Residential 1/	1,974	1,426	1,316	715
Commercial 1/	2,240	1,760	1,440	1,040
Transportation	850	800	750	500
Utility	150	70	60	55
Total Value	5,214	4,056	3,566	2,310
Damage ($1,000)				
Residential	127.7	105.2	92.0	33.5
Commercial	190.1	145.7	120.4	60.4
Transportation	8.5	7.8	7.3	5.5
Utility	3.1	2.6	2.2	0.2
Total Damage	329.4	261.3	221.9	99.6
Reach PR-6				
Area in Acres	70	66	60	53
Number Units Residential	90	82	76	63
Property Value ($1,000)				
Residential 1/	8,352	7,510	7,053	5,846
Transportation	800	675	550	400
Utility	230	210	190	165
Total Value	9,382	8,395	7,793	6,411
Damage ($1,000)				
Residential	1,852.0	1,723.4	1,399.3	922.9
Transportation	7.8	6.6	5.2	4.0
Utility	11.3	11.0	8.9	6.9
Total Damage	1,871.1	1,741.0	1,413.4	933.8
Reach PR-7				
Area in Acres	70	70	46	22
Number Units Residential	53	51	45	40
Property Value ($1,000)				
Residential 1/	5,500	5,100	4,490	4,000
Transportation	550	400	300	0
Utility	140	135	115	100
Total Value	6,190	5,635	4,905	4,100
Damage ($1,000)				
Residential	965.0	877.0	631.7	375.2
Transportation	7.0	4.0	0.7	0.0
Utility	10.0	8.0	5.3	3.9
Total Damage	982.0	889.0	637.7	379.1

TABLE E-9 (Cont'd)

Stream Reach and Category	Flood Height SPF	500-Yr	100-Yr	25-Yr
Reach PR-8				
Area in Acres	63	54	45	37
Number Units Residential	25	24	22	19
Property Value (\$1,000)				
Residential 1/	2,040	1,961	1,798	1,553
Transportation	500	400	220	130
Utility	70	67	62	53
Total Value	2,610	2,428	2,080	1,736
Damage (\$1,000)				
Residential	318.0	310.0	180.6	102.5
Transportation	5.0	3.8	2.1	1.3
Utility	3.5	3.0	2.6	1.9
Total Damage	326.5	316.8	185.3	105.7
Reach PR-9 (RB Ponding)				
Area in Acres	36	34	33	31
Number Units Residential	112	108	100	65
Property Value (\$1,000)				
Residential 1/	5,650	5,460	5,050	3,280
Transportation	250	210	200	170
Utility	270	260	240	156
Total Value	6,170	5,930	5,490	3,606
Damage (\$1,000)				
Residential	670.0	599.5	545.7	455.9
Transportation	22.0	20.7	19.0	16.3
Utility	10.4	9.0	7.5	4.6
Total Damage	702.4	629.2	572.2	476.8
Reach PR-10 (RB Ponding)				
Area in Acres	60	55	42	36
Number Units Residential	49	37	33	26
Property Value (\$1,000)				
Residential 1/	3,000	2,260	2,010	1,583
Transportation	265	220	190	160
Utility	140	100	86	65
Total Value	3,405	2,580	2,286	1,808
Damage (\$1,000)				
Residential	226.3	209.9	195.6	180.2
Transportation	25.3	21.6	18.3	15.5
Utility	3.7	3.4	3.0	2.7
Total Damage	255.3	234.9	216.9	198.4

TABLE E-9 (Continued)

Stream Reach and Category	Flood Height SPF	500-Yr	100-Yr	25-Yr
Reach PR-11 (RB Ponding)				
Area in Acres	42	40	39	34
Number Units Residential	40	36	33	27
Property Value ($1,000)				
Residential 1/	2,000	1,800	1,650	1,350
Transportation	700	700	700	600
Utility	115	100	92	75
Total Value	2,815	2,600	2,442	2,025
Damage ($1,000)				
Residential	125.0	116.1	110.0	88.2
Transportation	7.1	7.0	6.8	6.5
Utility	4.0	3.7	3.6	3.0
Total Damage	136.1	126.8	120.4	97.7
Reach PR-12 (RB Ponding)				
Area in Acres	60	50	24	19
Number Units Residential	74	70	57	53
Property Value ($1,000)				
Residential 1/	4,955	4,687	3,820	3,550
Transportation	800	700	500	300
Utility	208	196	160	148
Total Value	5,963	5,583	4,480	3,998
Damage ($1,000)				
Residential	503.8	468.2	158.9	59.6
Transportation	13.4	11.7	4.8	2.8
Utility	7.7	7.1	5.9	4.7
Total Damage	524.9	487.0	169.6	67.1
Reach PR-13A (RB Ponding)				
Area in Acres	14	13	10	0
Number Units Residential	19	18	17	0
Property Value ($1,000)				
Residential 1/	809	766	725	0
Transportation	700	500	300	0
Utility	50	48	45	
Total Value	1,559	1,314	1,070	0
Damage ($1,000)				
Residential	72.5	66.6	58.8	0
Transportation	9.3	6.3	3.2	0
Utility	9.0	7.1	6.1	0
Total Damage	90.8	80.0	68.1	0

TABLE E-9 (Continued)

Stream Reach and Category	Flood Height SPF	500-Yr	100-Yr	25-Yr
Reach PR-13B				
Area in Acres	40	37	33	27
Number Units Residential	96	84	66	10
Property Value ($1,000)				
Residential [1]	3,552	3,108	2,451	375
Transportation	1,000	800	500	125
Utility	250	220	170	25
Total Value	4,802	4,128	3,121	525
Damage ($1,000)				
Residential	406.8	376.4	292.0	125.2
Transportation	23.8	21.1	6.3	1.3
Utility	9.7	8.8	4.3	0.9
Total Damage	440.3	406.3	302.6	127.4
GM Ditch				
Reach GM-1A				
Area in Acres	60	41	25	15
Number Units Residential	24	22	21	20
Property Value ($1,000)				
Residential [1]	1,440	1,320	1,260	1,200
Transportation	900	700	650	500
Utility	62	57	55	50
Total Value	2,402	2,077	1,965	1,750
Damage ($1,000)				
Residential	362.9	312.1	250.5	173.5
Transportation	9.8	7.5	6.6	5.4
Utility	3.8	3.1	2.8	1.6
Total Damage	376.5	322.7	259.9	180.5
Reach GM-1B				
Area in Acres	73	60	49	37
Number Units Residential	90	80	71	57
Property Value ($1,000)				
Residential [1]	5,580	4,960	4,400	3,532
Transportation	250	220	200	150
Utility	234	208	185	148
Total Value	6,064	5,388	4,785	3,830
Damage ($1,000)				
Residential	1,109.7	929.9	646.8	384.3
Transportation	20.4	19.5	17.8	14.7
Utility	14.0	12.5	9.9	5.9
Total Damage	1,144.1	961.9	674.5	404.9

TABLE E-9 (Continued)

Stream Reach and Category	Flood Height SPF	500-Yr	100-Yr	25-Yr
High School Tributary				
Reach HST-2				
Area in Acres	61	55	47	41
Number Units Residential 2/	85	75	60	53
Commercial	1	1	1	1
Total Units	86	76	61	54
Property Value ($1,000)				
Residential 1/	2,680	2,365	1,892	1,671
Commercial 1/	700	700	700	700
Transportation	Nil	Nil	Nil	Nil
Utility	Nil	Nil	Nil	Nil
Total Value	3,380	3,065	2,592	2,371
Damage ($1,000)				
Residential	141.0	107.7	87.9	39.7
Commercial	84.6	71.5	60.0	43.6
Transportation	-	-	-	-
Utility	-	-	-	-
Total Damage	225.6	179.2	147.9	83.3
East Fork Tributary				
Reach EFT-1				
Area in Acres	37	35	31	27
Number Units Residential	38	35	35	27
Property Value ($1,000)				
Residential 1/	3,770	3,470	3,470	2,690
Transportation	500	400	350	280
Utility	125	116	116	80
Total Value	4,395	3,986	3,936	3,050
Damage ($1,000)				
Residential	662.5	605.0	422.3	256.5
Transportation	4.8	4.0	3.4	2.8
Utility	5.0	4.6	3.6	2.8
Total Damage	672.3	613.6	429.3	262.1

TABLE E-9 (Cont'd)

Stream Reach and Category	Flood Height SPF	500-Yr	100-Yr	25-Yr
Total Study Area				
Area in Acres	987	876	722	598
Number Units Residential	1,126	1,014	899	682
Commercial	43	37	30	23
Total Units	1,169	1,051	929	705
Property Value ($1,000)				
Residential 1/	73,230	65,800	58,884	46,487
Commercial 1/	6,540	6,060	4,960	4,035
Transportation	10,685	9,185	7,500	4,745
Utility	6,807	6,497	6,209	5,664
Total Value	97,262	87,542	77,553	60,931
Damage ($1,000)				
Residential	9,624.3	8,781.9	6,914.2	4,903.8
Commercial	375.7	317.2	280.3	152.4
Transportation	512.2	419.1	292.8	211.6
Utility	116.7	100.0	84.5	59.2
Total Damage	10,628.9	9,618.2	7,571.8	5,327.0

1/ Includes estimated value of structures, contents and grounds.
2/ Reflects numbers of apartments instead of apartment buildings.

Residential

Damages and losses evaluated include physical damages to real property items such as foundations, walls, floors, heating plant, auxiliary buildings and grounds and damages to contents such as furniture and personal items.

Commercial

This category includes wholesale, retail, and service establishments. Flood damages evaluated consist of physical damages to structures, grounds, merchandise and equipment.

Transportation

This category is limited to physical damages to roads and streets.

Utility

This category consists of an evaluation of physical damages to electrical, telephone, natural gas and water distribution lines and facilities. Damages were determined for each property category by estimating the number of users for each utility and damage per user based on flood height.

NONPHYSICAL FLOOD DAMAGES

Nonphysical damage items considered consist of additional living expenses of residential occupants while living in temporary quarters and arranging for repair of physical damages and fixed costs such as mortgage equivalents and utility bills while residences are uninhabitable and losses of portions of living space in residences partly habitable while repairs are made. Commercial items considered include losses of income, rental, and employee wages and fixed costs similar to those described for residences. Other considerations include costs incurred by businesses to temporarily close during cleanup and while repairs of physical damages are made. Nonphysical damages to utilities were considered insignificant due to relatively shallow flooding and short flood durations.

These nonphysical items were analyzed in considerable detail during the Flood Damage Report for Frankfort, Kentucky, dated July 1981. Unit damages derived during this study were used as basic criteria in estimating nonphysical damages for the Pleasant Run study area. These damages are dependent on numbers of units affected and durations of various flood heights. Table E-10 shows estimates of nonphysical damages by reach-related to residential and commercial properties. Damages are estimated in this table for 25-year and 500-year flood heights.

TABLE E-10

RESIDENTIAL AND COMMERCIAL NONPHYSICAL DAMAGE ESTIMATES
FROM RECURRENCE OF 25-YEAR AND 500-YEAR FLOOD HEIGHTS
1980 DEVELOPMENT AND HYDROLOGIC CONDITIONS
PLEASANT RUN AND TRIBUTARIES, FAIRFIELD, OHIO
(October 1980 Price Levels)

Stream and Reach	Units Affected 1/		Average Duration 2/		Unit Damage Per Day 3/	Total Damage 4/	
	25-Yr Flood	500-Yr Flood	25-Yr Flood	500-Yr Flood		25-Yr Flood	500-Yr Flood
	(1)	(2)	(3)	(4)	(5) (Dollars)	(6) (Dollars)	(7) (Dollars)
Pleasant Run							
PR-2 Residential	27	34	5	15	20	3,000	10,000
PR-3 Residential	110	154	5	20	20	11,000	62,000
PR-3A Rsidential	32	38	10	20	20	6,000	15,000
PR-4A & 4B Residential	40	40	10	20	20	8,000	16,000
Commercial	9	14	3	5	530	14,000	37,000
PR-5 Residential	13	29	5	10	20	1,000	6,000
Commercial	10	22	1	3	530	5,000	35,000
PR-6 Residential	82	103	15	30	20	25,000	62,000
PR-7 Residential	36	47	15	30	20	11,000	28,000
PR-8 Residential	19	24	15	25	20	6,000	12,000
PR-9 Residential	65	108	8	15	20	10,000	32,000
PR-10 Residential	26	37	8	15	20	4,000	11,000
PR-11 Residential	27	36	8	15	20	4,000	11,000
PR-12 Residential	53	70	8	15	20	8,000	21,000
PR-13A Residential	0	17	0	15	20	0	5,000
PR-13B Residential	10	84	10	15	20	2,000	25,000
Subtotal						118,000	388,000
GM Ditch							
GM-1A Residential	20	22	15	25	20	6,000	11,000
GM-1B Residential	57	80	15	25	20	17,000	40,000
Subtotal						23,000	51,000

TABLE E-10 (Continued)

Stream and Reach	Units Affected 1/		Average Duration 2/		Unit Damage Per Day 3/	Total Damage 4/	
	25-Yr Flood	500-Yr Flood	25-Yr Flood	500-Yr Flood		25-Yr Flood	500-Yr Flood
	(1)	(2)	(3)	(4)	(5) (Dollars)	(6) (Dollars)	(7) (Dollars)
High School Tributary							
HST-2 Residential	53	75	5	10	20	5,000	15,000
Commercial	1	1	5	10	530	3,000	5,000
Subtotal						8,000	20,000
East Fork Tributary							
EFT-1 Residential	26	40	15	25	20	8,000	20,000
Total Study Area							
Residential						135,000	402,000
Commercial						22,000	77,000
TOTAL						157,000	479,000

1/ Refers to structural units
2/ Estimated average duration of floods and their after effects in 24-hour days.
3/ Based on average unit damages derived during current flood damage studies at Frankfort, Kentucky.
4/ Column (6) = Columns (1) x (3) x (5); Column (7) = columns (2) x (4) x (5).

Costs were estimated due to diversion of vehicular traffic during flood periods on the basis of numbers of households. This method involves determination of the degree of traffic impact (high, medium, low) depending on density, proximity and character of households and normal traffic patterns. Traffic diversion cost per household per day was estimated in Frankfort at $13.35, which is considered "high impact". Derivation of this unit cost is discussed in considerable detail in Section F of the Frankfort study. Per unit costs for "high impact" are estimated to range from $8.91 to $13.35, "medium impact" from $4.46 to $8.90, and "low impact" less than $4.46. Traffic diversion at Fairfield was estimated in the low end of the "medium impact" range, or about $4.50 per household per day. Households considered appropriate for the Fairfield study include the entire Fairfield-Hamilton urban area. Traffic diversion costs are derived in Table E-11 for the Pleasant Run study area on the basis of estimated durations of the 500-year and 25-year floods. Total costs for these flood heights were apportioned to the various study reaches primarily on the basis of households.

TABLE E-11

TRAFFIC DIVERSION COST ESTIMATES
FROM RECURRRENCE OF 25-YEAR AND 500-YEAR FLOOD HEIGHTS
1980 DEVELOPMENT AND HYDROLOGIC CONDITIONS
PLEASANT RUN AND TRIBURARIES, FAIRFIELD, OHIO
(October 1980 Price Levels)

Item	Units Affected 1/	Average Duration 2/ 25-Yr Flood	Average Duration 2/ 500-Yr Flood	Cost Per Unit Per Day 3/	Total Cost 25-Yr Flood	Total Cost 500-Yr Flood
	(1)	(2)	(3)	(4) (Dollars)	(5) (Dollars)	(6) (Dollars)
Total Study Area	36,115	1/6	1/2	4.50	27,600 4/	81,300 5/
					Reach Breakdown 6/	
Pleasant Run						
PR-2					1,000	2,800
PR-3					0	12,000
PR-3A					0	3,000
PR-4A & 4B					500	800
PR-5					1,600	2,500
PR-6					4,300	8,200
PR-7					1,400	3,900
PR-8					900	2,000
PR-9					3,300	8,700
PR-10					1,500	2,900
PR-11					900	2,800
PR-12					3,400	5,600
PR-13A					0	1,400
PR-13B					2,000	6,800
Subtotal					$20,800	$63,400
GM Ditch						
GM-1A					1,100	1,700
GM-1B					2,300	6,200
Subtotal					3,400	7,900

TABLE E-11 (Cont'd)

Item	Units Affected 1/	Average Duration 2/		Cost Per Unit Per Day 3/	Total Cost	
		25-Yr Flood	500-Yr Flood		25-Yr Flood	500-Yr Flood
	(1)	(2)	(3)	(4)	(5)	(6)
				(Dollars)	(Dollars)	(Dollars)
High School Tributary						
HST-2					2,000	7,100
East Fork Tributary						
EFT-1					1,400	2,900

1/ Members of households in Fairfield-Hamilton urban area based on 1980 census.
2/ Estimated portion of 24-hour day that roads are closed during flood periods.
3/ Based on unit costs derived during current flood damage studies at Frankfort, Kentucky.
4/ Columns (1) x (2) x (4).
5/ Columns (1) x (3) x (4).
6/ Reach breakdown in approximate proportion to residential units.

AVERAGE ANNUAL FLOOD DAMAGES

Damage estimates for the various flood heights shown in Tables E-9, E-10 and E-11 were used to plot physical and nonphysical damage curves for the property categories and stream reaches. For illustrative purposes, damage curves are shown by category for Reach PR-6 on Plates E-2 through E-6. This is the most flood-prone reach studied. Plate E-2 shows separate curves for physical damages to residential structures and contents.

Average annual damages (AAD) were evaluated for the Pleasant Run study area based on both present and projected future hydrologic conditions. Present conditions refer to runoff from drainage areas with 1980 land use. Future conditions refer to accelerated runoff with land use projected by year 1995. Plate E-7 shows the drainage areas of Pleasant Run in which changes in land use are expected.

AAD, based on 1980 and 1995 hydrologic conditions, were computed by relating the elevation-damage curves discussed in the preceeding paragraphs with present and future condition elevation-natural frequency curves. The frequency curves used in this analysis are discussed in Appendix D - Hydrology and Hydraulics.

Average annual equivalent damages (AAED) are shown in Table E-12. Estimates in this table include all physical and nonphysical damages considered except emergency costs and flood insurance administrative costs. Columns (1) and (3) of this table show damage estimates based on 1980 and 1995 hydrologic conditions without project. Column (2) shows estimated AAD for year 1986 interpolated from 1980 and 1995 hydrologic AAD. Year 1986 is the base year or the projected first year that any of the considered structural plans could be implemented. Column (4) shows future incremental AAD. Columns (1) through (4) are undiscounted values. Columns (2), (3) and (4) also show affluence related increases in damageable residential structure contents. Derivation of this item is discussed in the benefits section. Column (5) shows 1986 to 1995 incremental damages discounted over a 50-year period at the current 7-3/8 percent Federal interest rate. Column (6) shows total AAED and is the sum of Columns (2) and (5).

TABLE E-12

PHYSICAL AND NONPHYSICAL
AVERAGE ANNUAL EQUIVALENT DAMAGES (AAED)
AT 7-3/8 PERCENT INTEREST RATE
PLEASANT RUN AND TRIBUTARIES, FAIRFIELD, OHIO
(October 1980 Price Levels in $1,000)

Stream Reach and Damage Item	Undiscounted Average Annual Damages				Discounted Future Increment AAED 4/ AT 7-3/8%	TOTAL 5/ AAED
	1980 Hydrology 1980 Develop. Study Year	1986 Hydrology 1986 Develop. 1/ Base Year	1995 Hydrology 2005 Develop. 2/ Future Year	Base Year to Future Year 3/ Increment		
	(1)	(2)	(3)	(4)	(5)	(6)
Pleasant Run						
PR-2 Physical	13.6	16.0	19.9	3.9	2.8	18.8
Affluence	0.0	0.9	4.7	3.8	2.8	3.7
Nonphysical	0.9	1.1	1.5	0.4	0.3	1.4
Subtotal	14.5	18.0	26.1	8.1	5.9	23.9
PR-3 Physical	26.2	37.8	64.7	26.9	19.0	56.8
Affluence	0.0	1.4	11.0	9.6	6.5	7.9
Nonphysical	0.5	0.7	1.0	0.3	0.3	1.0
Subtotal	26.7	39.9	76.7	36.8	25.8	65.7
PR-3A Physical	7.5	13.4	28.2	14.8	10.5	23.9
Affluence	0.0	0.6	5.6	5.0	3.3	3.9
Nonphysical	0.5	0.9	1.9	1.0	0.7	1.6
Subtotal	8.0	14.9	35.7	20.8	14.5	29.4
PR-4A & 4B Physical	30.6	54.5	196.0	141.5	100.4	154.9
Affluence	0.0	2.1	32.5	30.4	19.1	21.2
Nonphysical	0.9	1.6	5.3	3.7	2.6	4.2
Subtotal	31.5	58.2	233.8	175.6	122.1	180.3

TABLE E-12 (Continued)

Stream Reach and Damage Item	Undiscounted Average Annual Damages: 1980 Hydrology 1980 Develop. Study Year	1986 Hydrology 1986 Develop. 1/ Base Year	1995 Hydrology 2005 Develop. 2/ Future Year	Base Year to Future Year 3/ Increment	Discounted Future Increment AAED 4/ AT 7-3/8%	TOTAL 5/ AAED
	(1)	(2)	(3)	(4)	(5)	(6)
Pleasant Run						
PR-5 Physical	16.2	17.7	19.6	1.9	1.3	19.0
Affluence	0.0	0.1	0.9	0.8	0.5	0.6
Nonphysical	0.5	0.6	0.9	0.3	0.2	0.8
Subtotal	16.7	18.4	21.4	3.0	2.0	20.4
PR-6 Physical	103.2	161.3	296.4	135.1	95.2	256.5
Affluence	0.0	5.5	46.0	40.5	28.0	33.5
Nonphysical	2.3	3.7	8.0	4.3	3.0	6.7
Subtotal	105.5	170.5	350.4	179.9	126.2	296.7
PR-7 Physical	36.1	52.3	85.9	33.6	23.6	75.9
Affluence	0.0	1.3	8.3	7.0	5.3	6.6
Nonphysical	2.5	3.6	5.9	2.3	1.6	5.2
Subtotal	38.6	57.2	100.1	42.9	30.5	87.7
PR-8 Physical	7.7	10.9	17.7	6.8	4.8	15.7
Affluence	0.04	0.3	2.4	2.1	1.3	1.6
Nonphysical	0.6	0.9	1.4	0.5	0.4	1.3
Subtotal	8.3	12.1	21.5	9.4	6.5	18.6
PR-9 Physical	27.4	30.8	36.9	6.1	4.3	35.1
Affluence	0.0	1.6	8.7	7.1	5.1	6.7
Nonphysical	1.0	1.1	1.3	0.2	0.1	1.2
Subtotal	28.4	33.5	46.9	13.4	9.5	43.0

TABLE E-12 (Continued)

Stream Reach and Damage Item	Undiscounted Average Annual Damages: 1980 Hydrology 1980 Develop. Study Year	1986 Hydrology 1986 Develop. 1/ Base Year	1995 Hydrology 2005 Develop. 2/ Future Year	Base Year to Future Year 3/ Increment	Discounted Future Increment AAED 4/ AT 7-3/8%	TOTAL 5/ AAED
	(1)	(2)	(3)	(4)	(5)	(6)
Pleasant Run						
PR-10 Physical	23.1	29.0	36.0	7.0	5.3	34.3
Affluence	0.0	1.6	13.1	11.5	6.2	7.8
Nonphysical	0.9	1.1	1.5	0.4	0.3	1.4
Subtotal	24.0	31.7	50.6	18.9	11.8	43.5
PR-11 Physical	17.0	17.8	19.0	1.2	0.9	18.7
Affluence	0.0	0.5	3.0	2.5	1.9	2.4
Nonphysical	1.3	1.4	1.5	0.1	0.1	1.5
Subtotal	18.3	19.7	23.5	3.8	2.9	22.6
PR-12 Physical	8.8	9.1	9.8	0.7	0.5	9.6
Affluence	0.0	0.2	1.0	0.8	0.7	0.9
Nonphysical	1.2	1.3	1.4	0.1	0.1	1.4
Subtotal	10.0	10.6	12.2	1.6	1.3	11.9
PR-13A Physical	1.5	1.8	2.1	0.3	0.2	2.0
Affluence	0.0	0.1	0.5	0.4	0.3	0.4
Nonphysical	0.1	0.1	0.1	0.0	0.0	0.1
Subtotal	1.6	2.0	2.7	0.7	0.5	2.5
PR-13B Physical	12.9	14.6	17.2	2.6	1.9	16.5
Affluence	0.0	0.7	3.5	2.8	2.1	2.8
Nonphysical	0.5	0.5	0.5	0.0	0.0	0.5
Subtotal	13.4	15.8	21.2	5.4	4.0	19.8
Pleasant Run Total	345.5	502.5	1,022.8	520.3	363.5	866.0

TABLE E-12 (Continued)

Stream Reach and Damage Item	Undiscounted Average Annual Damages: 1980 Hydrology 1980 Develop. Study Year	1986 Hydrology 1986 Develop. 1/ Base Year	1995 Hydrology 2005 Develop. 2/ Future Year	Base Year to Future Year 3/ Increment	Discounted Future Increment AAED 4/ AT 7-3/8%	TOTAL 5/ AAED
	(1)	(2)	(3)	(4)	(5)	(6)
G.M. Ditch						
GM-1A Physical	15.0	20.1	30.2	10.1	7.1	27.2
Affluence	0.0	1.0	6.7	5.7	4.0	5.0
Nonphysical	0.9	1.2	1.6	0.4	0.3	1.5
Subtotal	15.9	22.3	38.5	16.2	11.4	33.7
GM-1B Physical	30.4	43.0	64.9	21.9	15.8	58.8
Affluence	0.0	2.2	14.1	11.9	8.8	11.0
Nonphysical	1.6	2.3	3.4	1.1	0.8	3.1
Subtotal	32.0	47.5	82.4	34.9	25.4	72.9
GM Ditch Total	47.9	69.8	120.9	51.1	36.8	106.6
High School Tributary						
HST-2 Physical	3.7	6.0	12.8	6.8	4.8	10.8
Affluence	0.0	0.2	1.3	1.1	0.7	0.9
Nonphysical	0.5	0.8	1.6	0.8	0.5	1.3
Subtotal	4.2	7.0	15.7	8.7	6.0	13.0
East Fork Tributary						
EFT-1 Physical	32.4	48.7	86.0	37.3	26.2	74.9
Affluence	0.0	1.1	7.2	6.1	4.6	5.7
Nonphysical	3.2	4.9	8.9	4.0	2.8	7.7
Subtotal	35.6	54.7	102.1	47.4	33.6	88.3

TABLE E-12 (Continued)

Stream Reach and Damage Item	Undiscounted Average Annual Damages: 1980 Hydrology 1980 Develop. Study Year	1986 Hydrology 1986 Develop. 1/ Base Year	1995 Hydrology 2005 Develop. 2/ Future Year	Base Year to Future Year 3/ Increment	Discounted Future Increment AAED 4/ AT 7-3/8%	TOTAL 5/ AAED
	(1)	(2)	(3)	(4)	(5)	(6)
Total Study Area						
Physical	413.3	584.8	1,043.3	458.5	324.6	909.4
Affluence	0.0	21.4	170.5	149.1	10 .2	122.6
Nonphysical	19.9	27.8	47.7	19.9	14.1	41.9
TOTAL	433.2	634.0	1,261.5	627.5	439.9	1,073.9

1/ Reflects undiscounted 1980 to 1986 hydrologic increases and 1980 to 1986 affluence growth in physical damages to residential contents. Amounts are cumulative.
2/ Reflects undiscounted 1986 to 1995 hydrologic increases and 1986 to 2005 affluence growth in physical damages to residential contents. Amounts are cumulative.
3/ Column (3) minus Column (2).
4/ Column (4) discounted over 50-year period.
5/ Column (2) plus Column (5).

FLOOD EMERGENCY COSTS

Emergency costs were evaluated in detail during the previously mentioned Frankfort, Kentucky, study. These costs were analyzed for a maximum flood of record that resulted in a Presidential Disaster Declaration. Emergency costs evaluated relates to protection of life, health, and property; evacuation, transition, and rehabilitation; emergency and mass care; and administrative costs associated primarily with the disaster declaration. Most of these costs relate to residential property.

Unit emergency costs derived during the Frankfort study were used as basic criteria in estimating emergency costs for the Pleasant Run study area. These costs are dependent on numbers of units affected and durations of various flood heights. Table E-13 shows the derivations of emergency costs by study reach for 500 year and 50 year future flood heights. Based on judgments expressed in the Frankfort study, unit cost shown in Table E-13 is considered applicable to floods expected to occur less frequently than once in 50 years. Further, emergency costs are estimated to decline to insignificance at about the elevation of a 25-year present natural flood.

TABLE E-13

FLOOD EMERGENCY COST ESTIMATES
FROM RECURRENCE OF 50-YEAR AND 500-YEAR FLOODS
1980 DEVELOPMENT AND 1995 HYDROLOGIC CONDITIONS
PLEASANT RUN AND TRIBUTARIES, FAIRFIELD, OHIO
(October 1980 Price Levels)

Stream and Reach	Units Affected 1/ 50-Yr Flood (1)	Units Affected 1/ 500-Yr Flood (2)	Average Duration 2/ 50-Yr Flood (3)	Average Duration 2/ 500-Yr Flood (4)	Unit Cost Per Day 3/ (5) (Dollars)	Total Cost 4/ 50-Yr Flood (6) (Dollars)	Total Cost 4/ 500-Yr Flood (7) (Dollars)
Pleasant Run							
PR-2	29	34	10	20	60	17,000	41,000
PR-3	120	154	10	20	60	72,000	185,000
PR-3A	34	38	10	20	60	20,000	46,000
PR-4A & 4B	50	54	10	20	60	30,000	65,000
PR-5	37	51	15	25	60	33,000	76,000
PR-6	89	103	30	60	60	160,000	371,000
PR-7	42	51	30	50	60	76,000	153,000
PR-8	20	24	25	40	60	30,000	58,000
PR-9	90	108	15	25	60	81,000	162,000
PR-10	30	37	15	25	60	27,000	56,000
PR-11	31	36	15	25	60	28,000	54,000
PR-12	58	70	15	25	60	52,000	105,000
PR-13A	14	17	15	25	60	13,000	25,000
PR-13B	52	84	10	20	60	31,000	101,000
Subtotal						670,000	1,498,000
G.M. Ditch							
GM-1A	21	22	20	40	60	25,000	53,000
GM 1B	65	80	25	40	60	98,000	192,000
Subtotal						123,000	245,000

TABLE E-13 (Cont'd)

Stream and Reach	Units Affected 1/ 50-Yr Flood (1)	Units Affected 1/ 500-Yr Flood (2)	Average Duration 2/ 50-Yr Flood (3)	Average Duration 2/ 500-Yr Flood (4)	Unit Cost Per Day 3/ (5) (Dollars)	Total Damage 4/ 50-Yr Flood (6) (Dollars)	Total Damage 4/ 500-Yr Flood (7) (Dollars)
High School Tributary							
HST-2	69	76	10	20	60	41,000	91,000
East Fork Tributary							
EFT-1	30	35	25	40	60	45,000	84,000
Total Study Area						$879,000	$1,918,000

1/ Refers to residential and commercial structural units.
2/ Estimated average duration of floods and their after effects in 24 hour days.
3/ Based on weighed average unit cost derived during current flood damage studies at Frankfort, Kentucky.
4/ Column (6) = Columns (1) x (3) x (5).
Column (7) = Columns (2) x (4) x (5).

AVERAGE ANNUAL FLOOD EMERGENCY COSTS

Total emergency cost estimates derived in Table E-13 and the height of the 25-year present natural flood were used to plot emergency cost curves for the various reaches. Plate E-8 shows an emergency cost curve for Reach PR-6. Average annual emergency costs shown in Table E-14 were computed by relating the emergency cost curves to the aforementioned present and future flow natural frequency curves.

COMPOSITE DAMAGE CURVES

Flood related damages represented by Plates E-2 through E-8 were composited for Reach PR-6 and are shown on Plate E-9. This composite damage curve was related to present and future natural frequency curves to derive the composite natural damage-frequency curves shown on Plate E-10.

TABLE E-14

AVERAGE ANNUAL EQUIVALENT
FLOOD EMERGENCY COSTS (AAEEC)
AT 7-3/8 PERCENT INTEREST RATE
PLEASANT RUN AND TRIBUTARIES, FAIRFIELD, OHIO
(October 1980 Price Levels in $1,000)

Stream Reach	Undiscounted Average Annual Costs 1980 Hydrology 1980 Develop. Study Year	1986 Hydrology 1980 Develop. Base Year	1995 Hydrology 1980 Develop. Future Year	Base Year to Future Year 1/ Increment	Discounted Future Increment AAEEC 2/ AT 7-3/8%	TOTAL 3/ AAEEC
	(1)	(2)	(3)	(4)	(5)	(6)
Pleasant Run						
PR-2	0.8	1.1	1.8	0.7	0.5	1.6
PR-3 & 3A	2.4	3.3	6.1	2.8	2.0	5.3
PR-4A & 4B	0.4	0.7	2.7	2.0	1.1	1.8
PR-5	1.2	1.5	2.1	0.6	0.5	2.0
PR-6	2.0	4.6	13.3	8.7	6.1	10.7
PR-7	2.8	4.5	8.5	4.0	2.8	7.3
PR-8	0.7	1.1	2.2	1.1	0.8	1.9
PR-9	2.5	2.8	3.5	0.7	0.5	3.3
PR-10	1.2	1.7	3.3	1.6	1.1	2.8
PR-11	0.9	1.0	1.4	0.4	0.3	1.3
PR-12	1.6	1.7	1.9	0.2	0.1	1.8
PR-13A	0.4	0.4	0.5	0.1	0.1	0.5
PR-13B	1.6	2.0	2.7	0.7	0.5	2.5
Subtotal	18.5	26.4	50.0	23.6	16.4	42.8
G.M. Ditch						
GM-1A	0.7	1.1	2.0	0.9	0.7	1.8
GM-1B	2.3	3.4	6.4	3.0	2.1	5.5
Subtotal	3.0	4.5	8.4	3.9	2.8	7.3
High School Tributary						
HST-2	0.7	1.2	3.3	2.1	1.4	2

TABLE E-14 (Continued)

Stream Reach	Undiscounted Average Annual Costs 1980 Hydrology 1980 Develop. Study Year (1)	1986 Hydrology 1980 Develop. Base Year (2)	1995 Hydrology 1980 Develop. Future Year (3)	Base Year to Future Year 1/ Increment (4)	Discounted Future Increment AAEEC 2/ AT 7-3/8% (5)	TOTAL 3/ AAEEC (6)
East Fork Tributary						
EFT-1	1.4	2.4	5.1	2.7	1.9	4.3
Total Study Area	23.6	34.5	66.8	32.3	22.5	57.0

1/ Column (3) minus Column (2).
2/ Column (4) discounted over 50 year period.
3/ Column (2) plus Column (5).

AVERAGE ANNUAL FLOOD INSURANCE COSTS

The cost of administering flood insurance policies was evaluated during the Frankfort, Kentucky, study based on information obtained from the National Flood Insurance Administration. These costs were estimated to average about $29 per policy, annually. Based on the estimated numbers of property units eligible for flood insurance within the present and future natural flood plains, and using a discounting technique similar to that used in Table E-12, average annual equivalent flood insurance administrative costs are shown in Table E-15.

SUMMARY OF FLOOD RELATED DAMAGES

Table E-16 shows a summary of average annual equivalent flood damages, emergency costs, and flood insurance administrative costs. Estimates were summarized in this table in order to display expected residual flood related damages with various candidate plans. Table E-17 displays undiscounted average annual flood related damages by 10-year intervals.

TABLE E-15

AVERAGE ANNUAL EQUIVALENT
FLOOD INSURANCE ADMINISTRATIVE COSTS (FIAC)
AT 7-3/8 PERCENT INTEREST RATE
PLEASANT RUN AND TRIBUTARIES, FAIRFIELD, OHIO
(October 1980 Price Levels in $1,000)

Stream Reach	Undiscounted Average Annual Cost: 1980 Hydrology 1980 Develop. Study Year (1)	1986 Hydrology 1980 Develop. Base Year (2)	1995 Hydrology 1980 Develop. Future Year (3)	Base Year to Future Year 1/ Increment (4)	Discounted Future Increment FIAC 2/ at 7-3/8% (5)	Total 3/ Cost (6)
Pleasant Run						
PR-2	0.9	0.9	1.0	0.1	0.1	1.0
PR-3 & 3A	5.2	5.3	5.6	0.3	0.2	5.5
PR-4A & 4B	1.7	1.7	1.7	0.0	0.0	1.7
PR-5	0.7	0.7	0.8	0.1	0.1	0.8
PR-6	2.6	2.7	2.9	0.2	0.1	2.8
PR-7	1.2	1.3	1.5	0.2	0.1	1.4
PR-8	0.7	0.7	0.7	0.0	0.0	0.7
PR-9	3.1	3.1	3.1	0.0	0.0	3.1
PR-10	1.0	1.0	1.0	0.0	0.0	1.0
PR-11	1.0	1.0	1.0	0.0	0.0	1.0
PR-12	2.0	2.0	2.0	0.0	0.0	2.0
PR-13A	0.5	0.5	0.5	0.0	0.0	0.5
PR-13B	2.4	2.4	2.4	0.0	0.0	2.4
Subtotal	23.0	23.3	24.2	0.9	0.6	23.9
G.M. Ditch						
GM-1A	0.6	0.6	0.6	0.0	0.0	0.6
GM-1B	2.2	2.2	2.3	0.1	0.1	2.3
Subtotal	2.8	2.8	2.9	0.1	0.1	2.9

TABLE E-15 (Cont'd)

Stream Reach	Undiscounted Average Annual Costs				Discounted Future Increment FIAC 2/ at 7-3/8%	Total 3/ Cost
	1980 Hydrology 1980 Develop. Study Year	1986 Hydrology 1980 Develop. Base Year	1995 Hydrology 1980 Develop. Future Year	Base Year to Future Year 1/ Increment		
	(1)	(2)	(3)	(4)	(5)	(6)
High School Tributary						
HST-2	1.7	1.9	2.2	0.3	0.2	2.1
East Fork Triburary						
EFT-1	1.0	1.0	1.0	0.0	0.0	1.0
Total Study Area	28.5	29.0	30.3	1.3	0.9	29.9

1/ Column (3) minus Column (2).
2/ Column (4) discounted over 50-year period.
3/ Column (2) plus Column (5).

TABLE E-16

SUMMARY OF AVERAGE ANNUAL EQUIVALENT
FLOOD RELATED DAMAGES
AT 7-3/8 PERCENT INTEREST RATE
PLEASANT RUN STUDY AREA, FAIRFIELD, OHIO
(October 1980 Price Levels in $1,000)

Stream Reach	Physical Flood Damages 1/	Nonphysical Flood Damages	Flood Emergency Costs	Flood Insurance Adm. Costs	Total
	(1)	(2)	(3)	(4)	(5)
Pleasant Run					
PR-2	22.5	1.4	1.6	1.0	26.5
PR-3 & 3A	92.5	2.6	5.3	5.5	105.9
PR-4A & 4B	176.1	4.2	1.8	1.7	183.8
PR-5	19.6	0.8	2.0	0.8	23.2
PR-6	290.0	6.7	10.7	2.8	310.2
PR-7	82.5	5.2	7.3	1.4	96.4
PR-8	17.3	1.3	1.9	0.7	21.2
PR-9	41.6	1.2	3.3	3.1	49.4
PR-10	42.1	1.4	2.8	1.0	47.3
PR-11	21.1	1.5	1.3	1.0	24.9
PR-12	10.5	1.4	1.8	2.0	15.7
PR-13A	2.4	0.1	0.5	0.5	3.5
PR-13B	19.3	0.5	2.5	2.4	24.7
Subtotal	837.7	28.3	42.8	23.9	932.7
G.M. Ditch					
GM-1A	32.2	1.5	1.8	0.6	36.1
GM-1B	69.8	3.1	5.5	2.3	80.7
Subtotal	102.0	4.6	7.3	2.9	116.8
High School Tributary					
HST-2	11.7	1.3	2.6	2.1	17.7
East Fork Tributary					
EFT-1	80.6	7.7	4.3	1.0	93.6
Total Study Area	1,032.0	41.9	57.0	29.9	1,160.8

1/ Includes affluence.

TABLE E-17

AVERAGE ANNUAL FLOOD RELATED DAMAGES
BY 10-YEAR INTERVALS (UNDISCOUNTED)
PLEASANT RUN STUDY AREA, FAIRFIELD, OHIO
(October 1980 Price Levels in $1,000)

Item	1980	1986 1/	1995	2005	2015	2025	2035
Physical Damages 2/	413.3	606.2	1,043.3	1,213.8	1,213.8	1,213.8	1,213.8
Nonphysical Damages	19.9	27.8	47.7	47.7	47.7	47.7	47.7
Emergency Costs	23.6	34.5	66.8	66.8	66.8	66.8	66.8
Flood Insurance Costs	28.5	29.0	30.3	30.3	30.3	30.3	30.3
Total	485.3	697.5	1,188.1	1,358.6	1,358.6	1,358.6	1,358.6

1/ Base year.
2/ Includes affluence.

BENEFITS

The following paragraphs discuss evaluations of various items related to reduction of flooding. These items include reduction of physical and nonphysical damages, emergency costs, and flood insurance administrative cost. Evaluations of benefits unrelated to reduction of flooding are also discussed. These items include advance replacement of bridges, projected property value increases due to open spaces created by the considered upstream reservoirs, recreation, and operation and maintenance cost savings. Candidate plans being considered in these evaluations are briefly described as follows:

Plan 1/	Degree of Protection	General Description
K	35-year (Future)	Channel enlargement
H	35-year (Future)	3 reservoirs plus channel enlargement
J	100-year (Future)	3 reservoirs plus channel enlargement
I	100-year (Future)	3 reservoirs plus non-structural measures

1/ Refers to frequency curve designation.

AVERAGE ANNUAL FLOOD REDUCTION BENEFITS

Benefits credited to the tentatively selected plan and the other candidate plans were computed for 1980 and 1995 flows as the difference in average annual damages (physical and nonphysical) and in average annual emergency costs without and with the various plans. The without (natural) and with (modified) average annual estimates were derived by relating the damage and emergency cost curves to natural and modified present (1980) and future (1995) flow frequency curves. These curves were previously discussed in this report. Composite damage-frequency curves modified by the tentatively selected plan are shown for Reach PR-6 on Plate E-10 for present and future hydrologic conditions. These curves include physical and nonphysical damages and emergency costs.

Reductions in flood insurance administrative costs were determined for 1980 and 1995 flows on the basis of estimated insurable units without and with the various plans. Each of these plans would eliminate the need for flood insurance on some structures in the study area.

Affluence benefits to base year and future year residential property contents were evaluated based on per capita income projected by OBERS for BEA Economic Area 062, the area in which the study area is located. The affluence projections were carried out to the year in which the value of contents equate to 75 percent of the value of the residential structures with no increase thereafter. The average year the 75 percent limit is reached for the various reaches is 2005.

Table E-18 shows detailed derivation of average annual equivalent benefits to the tentatively selected plan that are related to flood reduction. Benefits are broken down in this table by study reach for physical, affluence, nonphysical, emergency and flood insurance categories. The same interpolating and discounting techniques were used in this table as used in Tables E-12, E-14 and E-15. Total average annual equivalent benefits for the above categories are summarized for the four candidate plans as follows:

Plan	Benefits
F 35-Yr Channel Enlargement	$ 941,000
H 35-Yr Channel Enlargement and Reservoirs	1,110,000
J (Tentatively Selected) 100-Yr Channel Enlargement and Reservoirs	1,122,000
I 100-Yr Reservoirs and Nonstructural	1,174,000

Table E-19 shows undiscounted average annual equivalent benefits by 10-year intervals to the tentatively selected plan that are related to flood reduction.

TABLE E-18

AVERAGE ANNUAL EQUIVALENT BENEFITS
RELATED TO FLOOD REDUCTION BY
TENTATIVELY SELECTED PLAN (PLAN J)
AT 7-3/8 PERCENT INTEREST RATE
PLEASANT RUN STUDY AREA, FAIRFIELD, OHIO
(October 1980 Price Levels in $1,000)

Stream Reach and Benefit Item	Undiscounted Average Annual Benefits: 1980 Hydrology 1980 Develop. Study Year	1986 Hydrology 1986 Develop. 1/ Base Year	1995 Hydrology 2005 Develop. 2/ Future Year	Base Year to Future Year 3/ Increment	Discounted Future Increment AAEB 4/ at 7-3/8%	Total 5/ AAEB
	(1)	(2)	(3)	(4)	(5)	(6)
Pleasant Run						
PR-2						
Physical	13.1	15.4	19.2	3.8	2.8	18.2
Affluence	0.0	0.9	4.5	3.6	2.7	3.6
Nonphysical	0.9	1.1	1.5	0.4	0.3	1.4
Emergency Cost 6/	0.8	1.1	1.8	0.7	0.5	1.6
Flood Insurance Cost 6/	0.4	0.4	0.4	0.0	0.0	0.4
Subtotal	15.2	18.9	27.4	8.5	6.3	25.2
PR-3 & 3A						
Physical	33.7	51.2	91.8	40.6	28.6	79.8
Affluence	0.0	2.0	16.4	14.4	9.7	11.7
Nonphysical	1.0	1.6	3.0	1.4	1.0	2.6
Emergency Cost 6/	2.4	3.3	6.0	2.7	2.0	5.3
Flood Insurance Cost 6/	5.2	5.3	5.6	0.3	0.2	5.5
Subtotal	42.3	63.4	122.8	59.4	41.5	104.9
PR-4A & 4B						
Physical	31.4	54.3	197.3	143.0	100.7	155.0
Affluence	0.0	2.1	32.4	30.3	19.1	21.2
Nonphysical	0.9	1.6	5.3	3.7	2.6	4.2
Emergency Cost 6/	0.4	0.7	2.7	2.0	1.4	2.1
Flood Insurance Cost 6/	0.3	0.3	0.3	0.0	0.0	0.3
Subtotal	33.0	59.0	238.0	179.0	123.8	182.8

TABLE E-18 (Continued)

Stream Reach and Benefit Item	Undiscounted Average Annual Benefits: 1980 Hydrology 1980 Develop. Study Year (1)	1986 Hydrology 1986 Develop. 1/ Base Year (2)	1995 Hydrology 2005 Develop. 2/ Future Year (3)	Base Year to Future Year 3/ Increment (4)	Discounted Future Increment AAEB 4/ AT 7-3/8% (5)	Total 5/ AAEB (6)
PR-5						
Physical	3.8	5.1	6.3	1.2	1.1	6.2
Affluence	0.0	0.1	0.8	0.7	0.4	0.5
Nonphysical	0.5	0.5	0.7	0.2	0.2	0.7
Emergency Cost 6/	1.1	1.3	1.7	0.4	0.4	1.7
Flood Insurance Cost 6/	0.1	0.1	0.1	0.0	0.0	0.1
Subtotal	5.5	7.1	9.6	2.5	2.1	9.2
PR-6						
Physical	103.1	161.1	296.1	135.0	95.1	256.2
Affluence	0.0	5.5	46.0	40.5	28.0	33.5
Nonphysical	2.3	3.7	8.0	4.3	3.0	6.7
Emergency Cost 6/	2.0	4.6	13.3	8.7	6.1	10.7
Flood Insurance Cost 6/	2.2	2.3	2.5	0.2	0.1	2.4
Subtotal	109.6	177.2	365.9	188.7	132.3	309.5
PR-7						
Physical	32.7	47.3	76.9	29.6	20.8	68.1
Affluence	0.0	1.3	8.0	6.7	5.1	6.4
Nonphysical	2.3	3.3	5.3	2.0	1.4	4.7
Emergency Cost 6/	2.8	4.4	8.3	3.9	2.7	7.1
Flood Insurance Cost 6/	0.4	0.4	0.4	0.0	0.0	0.4
Subtotal	38.2	56.7	98.9	42.2	30.0	86.7
PR-8						
Physical	6.6	9.5	15.4	5.9	4.2	13.7
Affluence	0.0	0.2	2.1	1.9	1.2	1.4
Nonphysical	0.5	0.8	1.2	0.4	0.3	1.1
Emergency Cost 6/	0.7	1.0	2.1	1.1	0.8	1.8
Flood Insurance Cost 6/	0.2	0.2	0.2	0.0	0.0	0.2
Subtotal	8.0	11.7	21.0	9.3	6.5	[illegible]

TABLE E-18 (Continued)

Stream Reach and Benefit Item	Undiscounted Average Annual Benefits 1980 Hydrology 1980 Develop. Study Year (1)	1986 Hydrology 1986 Develop. 1/ Base Year (2)	1995 Hydrology 2005 Develop. 2/ Future Year (3)	Base Year to Future Year 3/ Increment (4)	Discounted Future Increment AAEB 4/ AT 7-3/8% (5)	TOTAL 5/ AAEB (6)
PR-9						
Physical Affluence	27.4	30.8	36.9	6.1	4.3	35.1
Nonphysical	0.0	1.5	8.5	7.0	5.0	6.5
Emergency Cost 6/	1.0	1.1	1.3	0.2	0.1	1.2
Flood Insurance Cost 6/	2.5	2.8	3.5	0.7	0.5	3.3
	3.1	3.1	3.1	0.0	0.0	3.1
Subtotal	34.0	39.3	53.3	14.0	9.9	49.2
PR-10						
Physical Affluence	23.1	29.0	36.0	7.0	5.3	34.3
Nonphysical	0.0	1.6	13.1	11.5	6.2	7.8
Emergency Cost 6/	0.9	1.1	1.5	0.4	0.3	1.4
Flood Insurance Cost 6/	1.2	1.7	3.3	1.6	1.1	2.8
	1.0	1.0	1.0	0.0	0.0	1.0
Subtotal	26.2	34.4	54.9	20.5	12.9	47.3
PR-11						
Physical Affluence	17.0	17.8	19.0	1.2	0.9	18.7
Nonphysical	0.0	0.5	2.7	2.2	1.7	2.2
Emergency Cost 6/	1.3	1.4	1.5	0.1	0.1	1.5
Flood Insurance Cost 6/	0.9	1.0	1.4	0.4	0.3	1.3
	1.0	1.0	1.0	0.0	0.0	1.0
Subtotal	20.2	21.7	25.6	3.9	3.0	24.7

TABLE E-18 (Continued)

Stream Reach and Benefit Item	Undiscounted Average Annual Benefits: 1980 Hydrology 1980 Develop. Study Year (1)	1986 Hydrology 1986 Develop. 1/ Base Year (2)	1995 Hydrology 2005 Develop. 2/ Future Year (3)	Base Year to Future Year 3/ Increment (4)	Discounted Future Increment AAEB 4/ AT 7-3/8% (5)	TOTAL 5/ AAEB (6)
PR-12						
Physical	8.7	9.0	9.7	0.7	0.5	9.5
Affluence	0.0	0.2	1.0	0.8	0.7	0.9
Nonphysical	1.2	1.3	1.4	0.1	0.1	1.4
Emergency Cost 6/	1.6	1.7	1.9	0.2	0.1	1.8
Flood Insurance Cost 6/	0.8	0.8	0.8	0.0	0.0	0.8
Subtotal	12.3	13.0	14.8	1.8	1.4	14.4
PR-13A						
Physical	1.4	1.7	2.0	0.3	0.2	1.9
Affluence	0.0	0.1	0.5	0.4	0.3	0.4
Nonphysical	0.1	0.1	0.1	0.0	0.0	0.1
Emergency Cost 6/	0.4	0.4	0.5	0.1	0.1	0.5
Flood Insurance Cost 6/	0.5	0.5	0.5	0.0	0.0	0.5
Subtotal	2.4	2.8	3.6	0.8	0.6	3.4
PR-13B						
Physical	10.8	12.5	14.9	2.4	1.7	14.2
Affluence	0.0	0.6	3.1	2.5	1.9	2.[illegible]
Nonphysical	0.4	0.4	0.4	0.0	0.0	0.4
Emergency Cost 6/	1.5	1.9	2.6	0.7	0.5	2.4
Flood Insurance Cost 6/	1.6	1.6	1.6	0.0	0.0	1.6
Subtotal	14.3	17.0	22.6	5.6	4.1	21.1
Pleasant Run Total	361.2	522.2	1,058.4	536.2	374.4	896.6

TABLE E-18 (Continued)

Stream Reach and Benefit Item	Undiscounted Average Annual Benefits: 1980 Hydrology 1980 Develop. Study Year (1)	1986 Hydrology 1986 Develop. 1/ Base Year (2)	1995 Hydrology 2005 Develop. 2/ Future Year (3)	Base Year to Future Year 3/ Increment (4)	Discounted Future Increment AAEB 4/ AT 7-3/8% (5)	TOTAL 5/ AAEB (6)
G.M. Ditch						
GM-1A						
Physical	14.7	19.8	29.9	10.1	7.1	26.9
Affluence	0.0	1.0	6.7	5.7	4.0	5.0
Nonphysical	0.9	1.2	1.6	0.4	0.3	1.5
Emergency Cost 6/	0.7	1.1	2.0	0.9	0.7	1.8
Flood Insurance Cost 6/	0.6	0.6	0.6	0.0	0.0	0.6
Subtotal	16.9	23.7	40.8	17.1	12.1	35.8
GM-1B						
Physical	30.4	43.0	64.9	21.9	15.8	58.8
Affluence	0.0	2.2	14.1	11.9	8.8	11.0
Nonphysical	1.6	2.3	3.4	1.1	0.8	3.1
Emergency Cost 6/	2.3	3.4	6.4	3.0	2.1	5.5
Flood Insurance Cost 6/	2.2	2.2	2.3	0.1	0.1	2.3
Subtotal	36.5	53.1	91.1	38.0	27.6	80.7
GM Ditch Total	53.4	76.8	131.9	55.1	39.7	116.5
High School Tributary						
HST-2						
Physical	3.3	5.4	11.3	5.9	4.2	9.6
Affluence	0.0	0.2	1.1	0.9	0.6	0.8
Nonphysical	0.4	0.6	1.4	0.8	0.6	1.2
Emergency Cost 6/	0.6	1.0	3.1	2.1	1.4	2.4
Flood Insurance Cost 6/	1.0	1.0	1.0	0.0	0.0	1.0
High School Tributary Total	5.3	8.2	17.9	9.7	6.8	15.0

TABLE E-18 (Continued)

Stream Reach and Benefit Item	Undiscounted Average Annual Benefits: 1980 Hydrology 1980 Develop. Study Year	1986 Hydrology 1986 Develop. 1/ Base Year	1995 Hydrology 2005 Develop. 2/ Future Year	Base Year to Future Year 3/ Increment	Discounted Future Increment AAEB 4/ AT 7-3/8%	TOTAL 5/ AAEB
	(1)	(2)	(3)	(4)	(5)	(6)
East Fork Tributary						
EFT-1						
Physical	32.4	48.7	86.0	37.3	26.2	74.9
Affluence	0.0	1.1	7.2	6.1	4.6	5.7
Nonphysical	3.2	4.9	8.9	4.0	2.8	7.7
Emergency Cost 6/	1.4	2.4	5.1	2.7	1.9	4.3
Flood Insurance Cost 6/	1.0	1.0	1.0	0.0	0.0	1.0
East Fork Tributary Total	38.0	58.1	108.2	50.1	35.5	93.6
Total Study Area						
Physical	393.6	561.6	1,013.6	452.0	319.5	881.1
Affluence	0.0	21.1	168.2	147.1	100.0	121.1
Nonphysical	19.4	27.0	46.5	19.5	13.9	40.9
Emergency Cost 6/	23.3	33.8	65.7	31.9	22.6	56.4
Flood Insurance Cost 6/	21.6	21.8	22.4	0.6	0.4	22.2
Total	457.9	665.3	1,316.4	651.1	456.4	1,121.7

1/ Reflects undiscounted 1980 to 1986 hydrologic increases and 1980 to 1986 affluence growth in physical benefits to residential contents. Amounts are cumulative.
2/ Reflects undiscounted 1986 to 1995 hydrologic increases and 1986 to 2005 affluence growth in physical benefits to residential contents. Amounts are cumulative.
3/ Column (3) minus Column (2).
4/ Column (4) discounted over 50 year period.
5/ Column (2) plus Column (5).
6/ Benefits from reduction of these costs.

TABLE E-19

AVERAGE ANNUAL BENEFITS RELATED TO FLOOD REDUCTION BY
TENTATIVELY SELECTED STRUCTURAL PLAN (PLAN J)
BY 10-YEAR INTERALS (UNDISCOUNTED)
PLEASANT RUN STUDY AREA, FAIRFIELD, OHIO
(October 1980 Price Levels in $1,000)

Benefit Item	1980	1986 1/	1995	2005	2015	2025	2035
Physical Damage Reduction 2/	393.6	582.7	1,013.6	1,181.8	1,181.8	1,181.8	1,181.8
Nonphysical Damage Reduction	19.4	27.0	46.5	46.5	46.5	46.5	46.5
Emergency Cost Reduction	23.3	33.8	65.7	65.7	65.7	65.7	65.7
Flood Insurance Cost Reduction	21.6	21.8	22.4	22.4	22.4	22.4	22.4
Total	457.9	665.3	1,148.2	1,316.4	1,316.4	1,316.4	1,316.4

1/ Base year
2/ Includes affluence.

BENEFITS FROM ADVANCE REPLACEMENT OF BRIDGES

Two of the candidate plans would require bridge replacements which would result in benefits due to advanced replacement. Plan J, the three reservoir with 100-year channel improvement plan, includes the replacement of the East River Road bridge and Plan K, the 35-year all-channel improvement plan, requires replacement of the East River Road, Nilles Road and Pleasant Avenue bridges. These bridges are assumed to have a remaining life of about 25 years which is 20 years after the 1986 base year for project evaluation. The State of Ohio has plans to replace the Nilles Road bridge in 1982, so no benefits are claimed for this bridge. The advanced replacement of these bridges would earn benefits for the considered plans equal to the annual costs accruing during the remaining project life after adjustment for the remaining life of the existing bridges. The annual benefits were derived by discounting the cost of the bridges, which would occur at year 2006 in the absence of the project, back to 1986 (base year for evaluation) and then amortizing the savings over the project life. The benefits derived from this procedure are shown in Table E-20.

TABLE E-20

BENEFITS FROM ADVANCE REPLACEMENT OF BRIDGES
AT 7-3/8 PERCENT INTEREST RATE
PLEASANT RUN STUDY AREA, FAIRFIELD, OHIO
(October 1980 Price Levels)

Plan and Bridge	Bridge Replacement Cost	Annual Benefits 1/
J - East River Road Bridge	$233,000	$ 3,900
K - East River Road Bridge and	233,000	3,900
Pleasant Avenue Bridge	394,000	6,500
Plan K Total		$10,400

1/ Benefits derived as follows:

First cost x interest and amortization (0.0759) x present worth of one per period for 30 years (11.956) x present worth of one for 20 years (0.24096) x interest and amortization (0.07591) = annual benefits.

OPEN SPACE BENEFITS

The open space considered in plans for reservoir sites A, C and D (see Plate E-11) incorporates significant urban amenity resources [1/] which would lead to enhanced value of property in the surrounding residential areas and contribute to city formation in terms of creating a lure for potential industrial activity and immigrants. In order to assess the extent to which the subject open space would improve value of existing and planned property within the surrounding residential corridors, a modified Delphi technique was used for soliciting opinions from planning, engineering, realty and building experts with recognized knowledge and experience in real estate development in Fairfield. This effort was pursued under the assumption that "open areas interspersed in a residential area may add to the value of every property". [2/] Although there was a consensus of opinion among experts that the urban amenity resources [3/] of the considered open space would increase the value of property throughout the residential corridors containing the proposed sites, opinions varied in assessing the average increase per unit from $500 to $1,500, exclusive of improving the general city environment. The average of $1,000 per unit was considered. It is conservatively assumed that this increase will be fully realized within 5 years of project completion. Table E-21 shows the derivation of annual benefits to property value increase estimates at the considered reservoir sites. These benefits are considered creditable to candidate plans H, J and I.

1/ For a classification of amenity resources of urban open space, see Arthur A. Atkisson and Ira M. Robinson, "Amenity Resources for Urban Living" in Harvey Perloff (ed.), The Quality of the Urban Environment (Johns Hopkins University Press, 1970), page 197, and Stanley B. Tankle, "The Importance of Open Space in the Urban Pattern," in Lowdon Wingo, Jr. (ed.), Cities and Space: The Future Use of Urban Land (John Hopkins University Press, 1963), page 61.

2/ This assumption is stated by Marion Clawson, "Open (Uncovered) Space" in Harvey S. Perloff (ed.), The Quality of the Urban Environment (Johns Hopkins University Press, 1970), page 168.

3/ See detailed description of considered improvements in Appendix B.

TABLE E-21

PROPERTY VALUE INCREASE BENEFITS DUE TO
OPEN SPACE AT CONSIDERED RESERVOIR SITES
AT 7-3/8 PERCENT INTEREST RATE
PLEASANT RUN STUDY AREA, FAIRFIELD, OHIO
(October 1980 Price Levels)

Reservoir Site	Open Space Acres	Units Per Acre	Number Units	Average Increase Per Unit	Total Increase	Annual Benefits 1/
A	441	2.25	992	$1,000	$ 992,000	$ 65,000
C	687	2.25	1,546	$1,000	$1,546,000	$102,000
D	386	2.25	867	$1,000	$ 867,000	$ 57,000
Total	1,514		3,405		$3,405,000	$224,000

1/ Benefits derived as follows:

Total increase value x interest and amortization factor x 5-year deferred growth factor ($3,405,000 x 0.07591 x 0.86798 = $224,000).

Justification of this assessment is based on four criteria. One, without the urban amenity resources of the considered open space, it would be doubtful that comparable resources would be developed in the city due to the scarcity of suitable residential land even at an average price of about $56,000 per prepared acre. Two, since the city has experienced a phenominal increase in housing stock of about 17[illegible] percent between 1970 and 1980, a trend which is expected to continue, this unusual demand for housing would quite likely eliminate available open space throughout the city. Three, although the floodway of the stream would remain undeveloped without the project, as an open space the floodway would not have urban amenity resources to contribute to city formation and improvement of property value. Four, developers in Fairfied emphasize the critical need for the considered open space because otherwise their city would develop am image of "congestion" in addition to the existing image of "flood prone" which would in the long-run lower the desirability of Fairfield as a living and working place,

and consequently, delimit their ability to make money, with an adverse impact on property value and ability of the city to attract industrial activity.

Contribution of the considered open space urban amenity resources to NED is based on alleviation of problems and realization of opportunities pursuant to Rules 711.31, 711.41, and 711.60 in Principles and Standards (PS), Part II, 1980, WRC, relative to enhancement benefits.

RECREATION BENEFITS

Recreation benefits are based on visitation estimates made through analysis of the recreation opportunities and physical carrying capacity of each candidate plan studied. Details on the methodology are presented in Appendix F - Recreation Resources.

It is estimated that Reservoir Site "A" will supply about 60,000 recreation days annually in 1990. Reservoir Site "C" will supply about 120,000 days and Site "D" will supply about 75,000 days.

Candidate Plan K includes work on about three miles of channel along Pleasant Run. Development of a trail system along one side of the channel could provide 100,000 recreation days of use per year.

For the purposes of this study, all unit recreation day values are the same. This value has been established through use of the unit day value method which employs use of the "Revised Table K-3 1 (FY 1981) - Conversion of Points to Dollar Values." The unit dollar value for recreational use is $1.80.

Based on the above, recreation benefits for the four candidate plans are summarized in the following tabulation.

Plan	Visitation	Benefits
K	100,000	$180,000
H	255,000	459,000
J	255,000	459,000
I	300,000	540,000

ANNUAL OPERATION AND MAINTENANCE COST SAVINGS BENEFITS

Under without project conditions, the City of Fairfield will incur annual cost for maintenance dredging and debris removal from Pleasant Run and its tributaries. The magnitude of the identified and intended action (Public Notice dated 16 March 1981 for a Department of the Army Permit, subject to Section 404 of the Clean Water Act) is estimated at 4,000 cubic yards of material per year. Work, to be performed twice yearly, would consist of dredging or excavating material from formed sand and gravel bars and removal of debris. Additional bank stabilization work consists of utilizing dumped rock or gabions estimated at 450 cubic yards per year.

The cost estimate for this work is estimated at $25,500 annually for the designated 10.8 miles of applicable stream channel. Annual costs are estimated as follows:

2,000 cy/yr excavated and utilized for bank reconstruction at $2.00/cy = $4,000

2,000 cy/yr excavated and removed to diked or disposal areas at $4.00/cy = $8,000

450 cy/yr of gabion or rock channel stabilization at $30.00/cy = $13,500

Total annual cost $25,500

As these costs cover estimated work throughout the 10.8 miles of stream channel, a reduction in the annual maintenance costs due to with project conditions is credited as a benefit to alternatives considered. The amount of credit depends on the length of stream included in the operation and maintenance plan for each alternative. The benefit allocation for each alternative, based on $2,400 annually per mile ($25,500 ÷ 10.8 mi) is as follows:

Alternative	Mileage 1/	Benefit/Year
Plan H - 35-yr - 3 reservoir plus 0.83 mile channel enlargement	4.83	$12,000
Plan J - 100-yr - 3 reservoir plus 1.37 miles channel enlargement	6.56	$15,700
Plan I - 100-yr - 3 reservoir plus nonstructural	4.1	$10,000
Plan K - 35-yr - all channel, 2.92 miles	2.92	$ 7,000

1/ Mileage assigned to each alternative represents the limits of the Federal project as defined for each alternative.

SUMMARY OF ANNUAL BENEFITS

Table E-22 summarizes annual benefits to the candidate plans for the various benefit categories that were evaluated.

RESIDUAL EFFECTS WITH CANDIDATE PLANS

Residual average annual equivalent flood related damage with the tentatively selected plan and with the other candidate plans are summarized in Table E-23. Undiscounted residual average annual flood related damages with the tentatively selected plan are displayed by 10-year intervals in Table E-24.

Table E-25 shows area, unit, value, and residual physical flood damages from recurrence of the SPF and 500-year flood heights with the tentatively selected plan. Table E-26 summarizes this residual data for these flood heights with the four candidate plans.

TABLE E-22

SUMMARY OF ANNUAL BENEFITS
TO THE FOUR CANDIDATE PLANS
AT 7-3/8 PERCENT INTEREST RATE
PLEASANT RUN STUDY AREA, FAIRFIELD, OHIO
(October 1980 Price Levels)

Benefit Category	Benefits in $1,000			
	Plan K	Plan H	Plan J 1/	Plan I
Physical Damage Reduction 2/	855	997	1,002	1,092 3/
Nonphysical Damage Reduction	29	40	41	- 3/
Emergency Cost Reduction	41	54	57	60
Flood Insurance Cost Reduction	16	19	22	22
Advance Bridge Replacements	10	-	4	-
Open Space	-	224	224	224
Recreation	180	459	459	542
O&M Cost Savings	7	12	16	10
Total	1,138	1,605	1,825	1,950

1/ Tentatively selected plan.
2/ Includes affluence.
3/ Plan I physical and nonphysical also includes flood insurance cost reduction and open space benefits for the nonstructural portion. The damages are not separated due to present computer post processing program.

TABLE E-23

SUMMARY OF RESIDUAL AVERAGE ANNUAL EQUIVALENT
FLOOD RELATED DAMAGES WITH THE FOUR CANDIDATE PLANS
AT 7-3/8 PERCENT INTEREST RATE
PLEASANT RUN STUDY AREA, FAIRFIELD, OHIO
(October 1980 Price Levels in $1,000)

Plan	Physical Flood 1/ Damages	Nonphysical Flood Damages	Flood Emergency Costs	Flood Insurance Adm. Cost	Total
	(1)	(2)	(3)	(4)	(5)
K	177	13	16	14	220
H	35	2	3	11	51
J 2/	30	1	Nil	8	39
I	15	1	0	8	24

1/ Includes affluence
2/ Tentatively selected plan.

TABLE E-24

RESIDUAL AVERAGE ANNUAL FLOOD RELATED DAMAGES
WITH THE TENTATIVELY SELECTED PLAN (PLAN J)
BY 10-YEAR INTERVALS (UNDISCOUNTED)
(October 1980 Price Levels in $1,000)

Item	1980	1986 1/	1995	2005	2015	2025	2035
Physical Damage 2/	19.7	23.5	29.7	32.0	32.0	32.0	32.0
Nonphysical Damage	0.5	0.8	1.2	1.2	1.2	1.2	1.2
Emergency Cost	0.3	0.7	1.1	1.1	1.1	1.1	1.1
Flood Insurance Cost	6.9	7.2	7.9	7.9	7.9	7.9	7.9
Total	27.4	32.2	39.9	42.2	42.2	42.2	42.2

1/ Base year.
2/ Includes affluence.

TABLE E-25

SUMMARY OF AREA, UNIT, VALUE AND RESIDUAL PHYSICAL DAMAGES
FROM RECURRENCE OF SPF AND 500-YEAR FLOOD HEIGHTS
1980 DEVELOPMENT AND 1995 HYDROLOGIC CONDITIONS
MODIFIED BY TENTATIVELY SELECTED PLAN (PLAN J)
PLEASANT RUN AND TRIBUTARIES, FAIRFIELD, OHIO
(October 1980 Price Levels)

Stream Reach and Category	Flood Height	
	SPF	500-Yr
Pleasant Run		
Reach PR-2		
Area in Acres	50	16
Number Units	34	15
Property Value ($1,000)	3,463	1,530
Damage ($1,000)	113.2	68.2
Reach PR-3		
Area in Acres	106	0
Number Units	132	0
Property Value ($1,000)	11,932	0
Damage ($1,000)	847.1	0
Reach PR-3A		
Area in Acres	0	0
Number Units	0	0
Property Value ($1,000)	0	0
Damage ($1,000)	0	0
Reach PR-4A & 4B		
Area in Acres	70	49
Number Units	52	9
Property Value ($1,000)	8,960	2,295
Damage ($1,000)	892.0	46.0
Reach PR-5		
Area in Acres	19	17
Number Units	48	39
Property Value ($1,000)	4,056	3,311
Damage ($1,000)	245.8	187.3
Reach PR-6		
Area in Acres	37	26
Number Units	40	14
Property Value ($1,000)	[illegible],070	1,425
Damage ($1,000)	260.0	57.5

TABLE E-25 (Cont'd)

Stream Reach and Category	Flood Height	
	SPF	500-Yr
Reach PR-7		
Area in Acres	24	13
Number Units	37	29
Property Value ($1,000)	3,793	2,975
Damage ($1,000)	413.3	202.2
Reach PR-8		
Area in Acres	46	37
Number Units	24	19
Property Value ($1,000)	2,428	1,736
Damage ($1,000)	231.5	104.2
Reach PR-9		
Area in Acres	32	4
Number Units	83	0
Property Value ($1,000)	4,234	400
Damage ($1,000)	517.7	4.5
Reach PR-10		
Area in Acres	25	12
Number Units	10	0
Property Value ($1,000)	695	0
Damage ($1,000)	105.2	0
Reach PR-11		
Area in Acres	24	8
Number Units	14	2
Property Value ($1,000)	973	140
Damage ($1,000)	58.4	6.9
Reach PR-12		
Area in Acres	19	12
Number Units	53	42
Property Value ($1,000)	3,998	3,160
Damage ($1,000)	67.1	16.8
Reach PR-13A		
Area in Acres	7	1
Number Units	7	0
Property Value ($1,000)	440	0
Damage ($1,000)	47.4	0
Reach PR-13B		
Area in Acres	31	29
Number Units	60	28
Property Value ($1,000)	3,150	1,324
Damage ($1,000)	266.3	192.4

TABLE E-25 (Cont'd)

Stream Reach and Category	Flood Height SPF	Flood Height 500-Yr
G.M. Ditch		
Reach GM-1A		
Area in Acres	10	6
Number Units	15	0
Property Value ($1,000)	1,501	300
Damage ($1,000)	107.0	2.0
Reach GM-1B		
Area in Acres	46	10
Number Units	68	2
Property Value ($1,000)	4,582	140
Damage ($1,000)	617.6	1.1
High School Tributary		
Reach HST-2		
Area in Acres	52	43
Number Units	66	62
Property Value ($1,000)	2,804	2,634
Damage ($1,000)	160.9	105.5
East Fork Tributary		
Reach EFT-1		
Area in Acres	25	0
Number Units	23	0
Property Value ($1,000)	2,600	0
Damage ($1,000)	218.0	0
Total Study Area		
Area in Acres	623	283
Number Units	766	261
Property Value ($1,000)	63,679	21,370
Damage ($1,000)	5,168.5	994.6

TABLE E-26

SUMMARY OF AREA, UNIT, VALUE AND RESIDUAL PHYSICAL DAMAGES
FROM RECURRENCE OF SPF AND 500-YEAR FLOOD HEIGHTS
1980 DEVELOPMENT AND 1995 HYDROLOGIC CONDITIONS
MODIFIED BY THE FOUR CANDIDATE PLANS
PLEASANT RUN AND TRIBUTARIES, FAIRFIELD, OHIO
(October 1980 Price Levels)

Stream Reach and Category	Flood Height SPF 1/	Flood Height 500-Yr
Plan K		
Area in Acres	688	401
Number Units	762	386
Property Value ($1,000)	64,816	33,911
Damage ($1,000)	6,208	2,860
Plan H		
Area in Acres	683	396
Number Units	784	397
Property Value ($1,000)	65,653	37,512
Damage ($1,000)	5,695	2,522
Plan J (Tentatively Selected)		
Area in Acres	623	283
Number Units	766	261
Property Value ($1,000)	63,679	21,370
Damage ($1,000)	5,168	995
Plan I		
Area in Acres	623	283
Number Units	717	212
Property Value ($1,000)	59,604	17,359
Damage ($1,000)	4,837	808

1/ Data for SPF for Plan K was approximated because profiles were not provided for this plan.

ECONOMIC JUSTIFICATION

Average annual costs and benefits, benefit to cost ratios, and net benefits for the four candidate plans are provided in Table E-27 based on an interest rate of 7-3/8 percent. Since the interest rate for non-Federal financing is higher than this rate and historically the Federal rate has increased yearly, an indication of the sensitivity of economic justification is appropriate. Although the sensitivity would vary with each plan, the tentatively selected plan, Plan J, was evaluated and the results are shown on Plate E-12. This plan would become economically infeasible when the interest rate reaches about 12.3 percent if all other factors remain the same. Expressed another way, this interest rate is the approximate internal rate of return for Plan J. As the maximum increase in the discount rate used by the Federal Government is 1/4-of 1 percent for any year [Chapter IV, D., "The Discount Rate" in the "Standards for Planning Water and Related Land Resources" of the Water Resources Council, as amended (39 FR 29242)], the plan would remain economically feasible for about the next 19 years, if all other factors remained relative. This is based on all of the benefit categories shown in Table E-22 and recreation development included in project cost.

TABLE E-27

SUMMARY OF FIRST COSTS, ANNUAL COSTS, ANNUAL BENEFITS, BENEFIT TO COST RATIO AND NET BENEFITS FOR THE FOUR CANDIDATE PLANS
PLEASANT RUN STUDY AREA, FAIRFIELD, OHIO
(October 1980 Price Levels in $1,000)

Plan	First Costs 1/	Annual Costs 1/	Annual Benefits 2/	B/C Ratio	Net Benefits
K	10,720	1,000	1,138	1.14	138
H	11,480	1,097	1,805	1.6	708
J (Tentatively Selected)	13,040	1,244	1,825	1.5	581
I	17,780	1,630	1,949	1.2	319

1/ With recreation.
2/ From Table E-22

Other economic feasibility checks performed include determination of the benefit to cost ratio of base year development and the project year that undiscounted benefits exceed annual charges. Based on year 1986, flood reduction related benefits of $665,000 (from Table E-18) and flood control annual charges of $960,000, the benefit to cost ratio applicable to the base year development and hydrologic conditions is 0.69 for Plan J. Plate E-13 shows an undiscounted benefit curve for Plan J (from Table E-19). This curve indicates undiscounted flood related benefits exceed annual flood control costs by 1990 or the fourth year after implementation of Plan J.

Table E-28 provides detailed economic feasibility sensitivity data for Plan J based on various benefit category combinations. Flood reduction benefits in this table are based on urbanization of the Pleasant Run drainage area by year 1995. In order to determine the economic sensitivity of drainage area urbanization, average annual equivalent benefits were also computed assuming urbanization of the drainage area by year 1990 and by year 2000. Table E-29 shows annual benefits, benefit to cost ratios and net benefit comparisons for Plan J based on drainage area urbanization by years 1990, 1995 and 2000.

TABLE E-28

SUMMARY OF ANNUAL BENEFITS, ANNUAL COSTS,
BENEFIT TO COST RATIO AND NET BENEFITS
FOR TENTATIVELY SELECTED PLAN (PLAN J)
WITH VARIOUS BENEFIT CATEGORY COMBINATIONS
PLEASANT RUN STUDY AREA, FAIRFIELD, OHIO
(October 1980 Price Levels in $1,000)

Benefit Category	Annual Benefits	Annual Costs 2/	Benefit to Cost Ratio	Net Benefits
Flood Reduction AAEB Only 1/	1,122	1,056	1.06	66
Flood Reduction AAEB plus Recreation	1,581	1,244	1.3	337
Flood Reduction AAEB plus Advance Bridge Replacement	1,126	1,056	1.07	70
Flood Reduction AAEB plus Recreation plus Advance Bridge Replacement	1,585	1,244	1.3	341
Flood Reduction AAEB plus Open Space	1,346	1,056	1.3	290
Flood Reduction AAEB plus Recreation plus Advance Bridge Replacement plus Open Space	1,809	1,244	1.5	565
Flood Reduction AAEB plus O&M Cost Savings	1,138	1,056	1.08	82
Flood Reduction AAEB plus Recreation plus Advance Bridge Replacement plus Open Space plus O&M Cost Savings	1,825	1,244	1.5	581

1/ Includes physical and nonphysical flood damage reduction and reduction of emergency cost and flood insurance administrative costs discounted to average annual equivalants at 7-3/8 percent.

2/ Computed at 7-3/8 percent.

TABLE E-29

ECONOMIC FEASIBILITY SENSITIVITY
FROM DRAINAGE AREA URBANIZATION WITH
TENTATIVELY SELECTED PLAN (PLAN J)
PLEASANT RUN STUDY AREA, FAIRFIELD, OHIO
(October 1980 Price Levels in $1,000)

Drainage Area Urbanized (year)	Annual Cost		Annual Benefit 1/		B/C Ratio		Net Benefits	
	With Recreation	Without Recreation	With Recreation	Without Recreation	With Recreation	Without Recreation	With Recreation	Without Recreation
1990	1,244	1,056	1,925	1,466	1.5	1.4	681	410
1995	1,244	1,056	1,825	1,366	1.5	1.3	581	310
2000	1,244	1,056	1,717	1,258	1.4	1.2	473	202

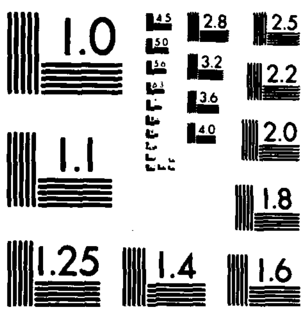
1/ Includes benefit categories shown in Table E-22.

AD-A111 738 ARMY ENGINEER DISTRICT LOUISVILLE KY F/G 13/2
WATER RESOURCES DEVELOPMENT MIAMI RIVER, LITTLE MIAMI RIVER, AN--ETC(U)
OCT 81

UNCLASSIFIED NL

6 of 6

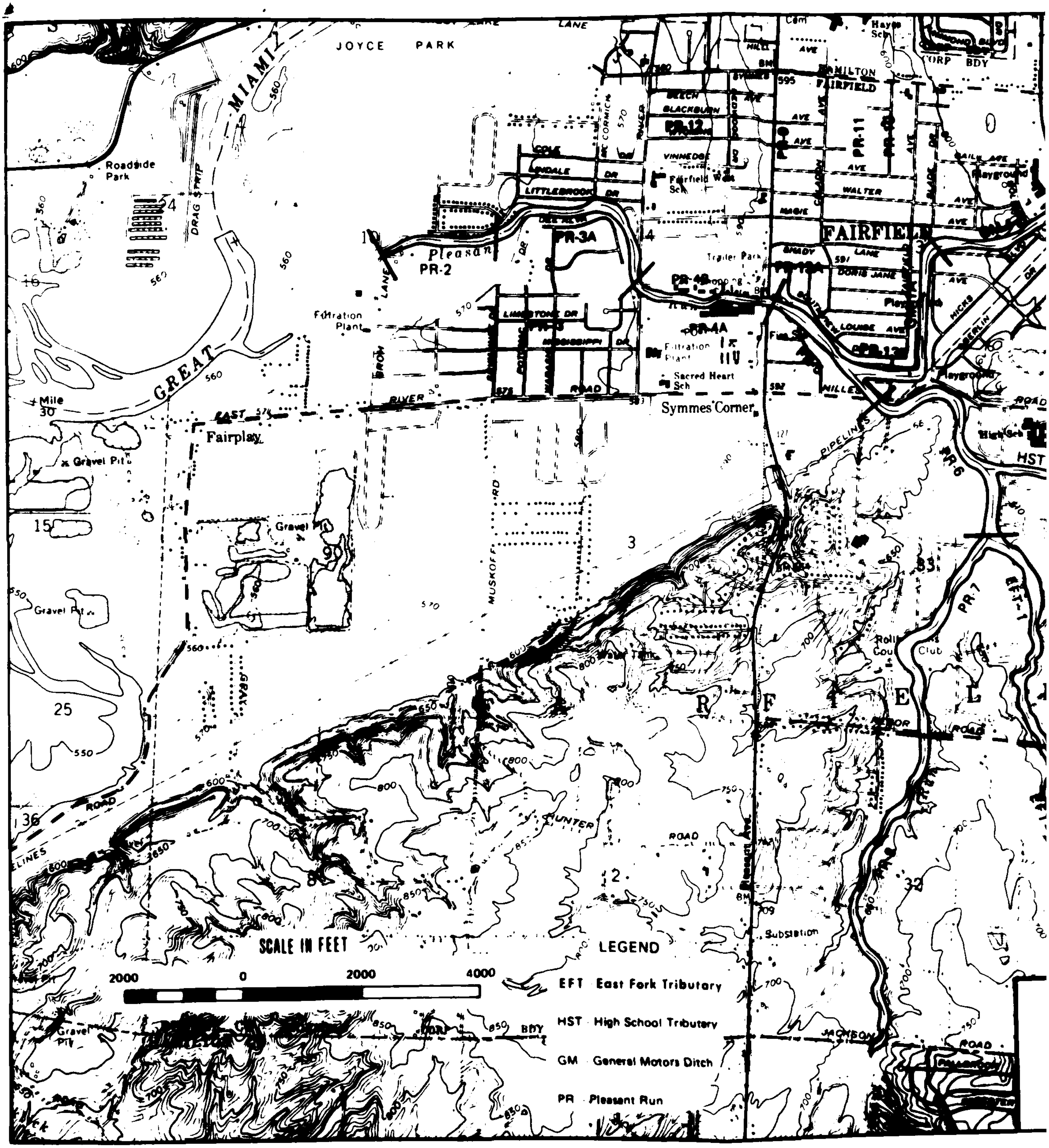
END
DATE
FILMED
4 82
DTIC



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Maximum net benefits indicate the plan with the greatest excess of benefits over cost. Of the candidate plans, Plan H had the largest net benefits. To determine the scale of the plan that optimizes net benefits, a graph of net benefits versus scale was plotted for several degrees of protection involving three dry bed reservoirs A, C, and D with channel improvement. This graph is shown on Plate E-14. The graph indicates that the plan maximizing net benefits would be one designed for about a 35-year future frequency flood.

APPENDIX E
PLATES


JOYCE PARK
GREAT MIAMI RIVER
FAIRFIELD
Symmes Corner
Fairplay
Roadside Park
DRAG STRIP
Filtration Plant
Sacred Heart Sch
Trailer Park
Water Tank
Substation
Gravel Pit
HAMILTON
FAIRFIELD
CORP BDY
PR-2
PR-3A
PR-4A
PR-4B
PR-6
PR-7
PR-11
PR-12
PR-13
PR-13A
EFT-1
HST
SCALE IN FEET
2000 0 2000 4000
LEGEND
EFT East Fork Tributary
HST High School Tributary
GM General Motors Ditch
PR Pleasant Run

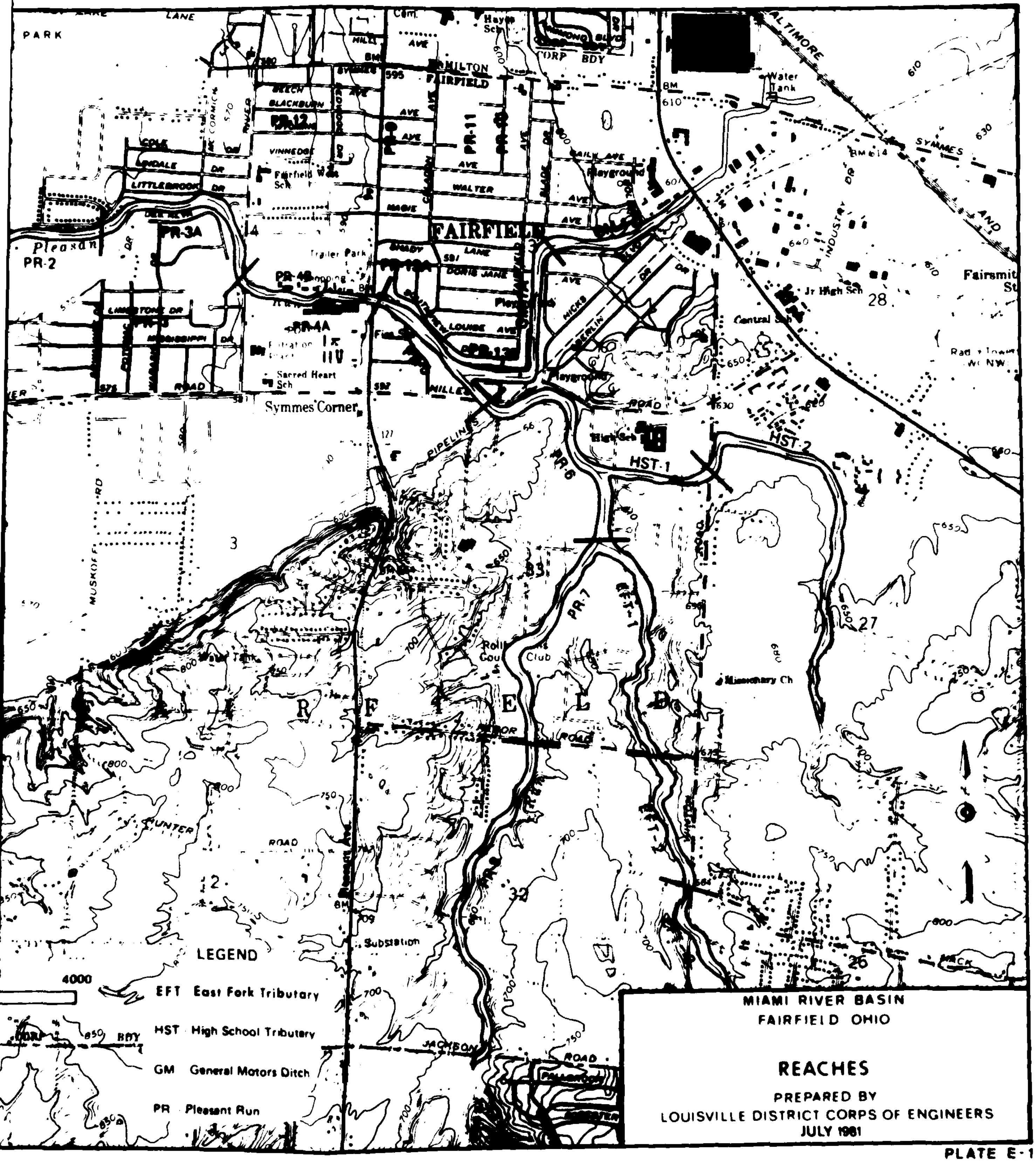

MIAMI RIVER BASIN
FAIRFIELD OHIO
REACHES
PREPARED BY
LOUISVILLE DISTRICT CORPS OF ENGINEERS
JULY 1981
LEGEND
EFT East Fork Tributary
HST High School Tributary
GM General Motors Ditch
PR Pleasent Run
4000
FAIRFIELD
Symmes Corner
PR-2
PR-3A
PR-4A
PR-6
PR-7
PR-11
PR-12
PR-13
HST-1
HST-2
EFT-1
Fairfield West Sch
Trailer Park
Sacred Heart Sch
High Sch
Jr High Sch
Central Sch
Water Tank
Substation
Missionary Ch
PIPELINES
BALTIMORE
SYMMES
INDUSTRY DR
HICKS
BERLIN
LOUISE AVE
WALTER
LITTLEBROOK DR
LIMESTONE DR
MISSISSIPPI DR
MUSKOFF RD
HUNTER
JACKSON
PARK
HAMILTON
CORP BDY

PLATE E-1

2

NO. 340R-10 DIETZGEN GRAPH PAPER
10 X 10 PER INCH

DIETZGEN CORPORATION
MADE IN U.S.A.

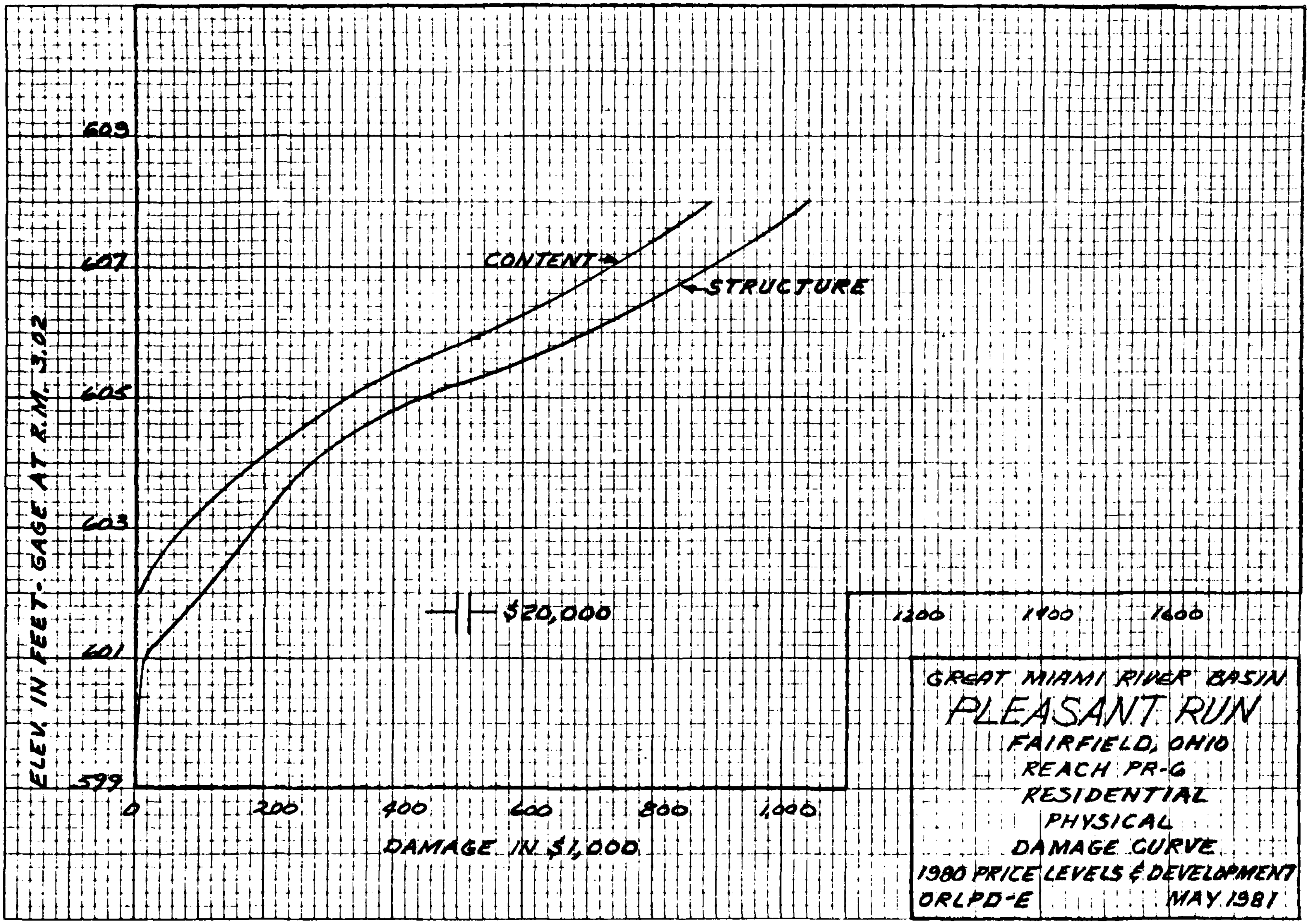


PLATE E-2

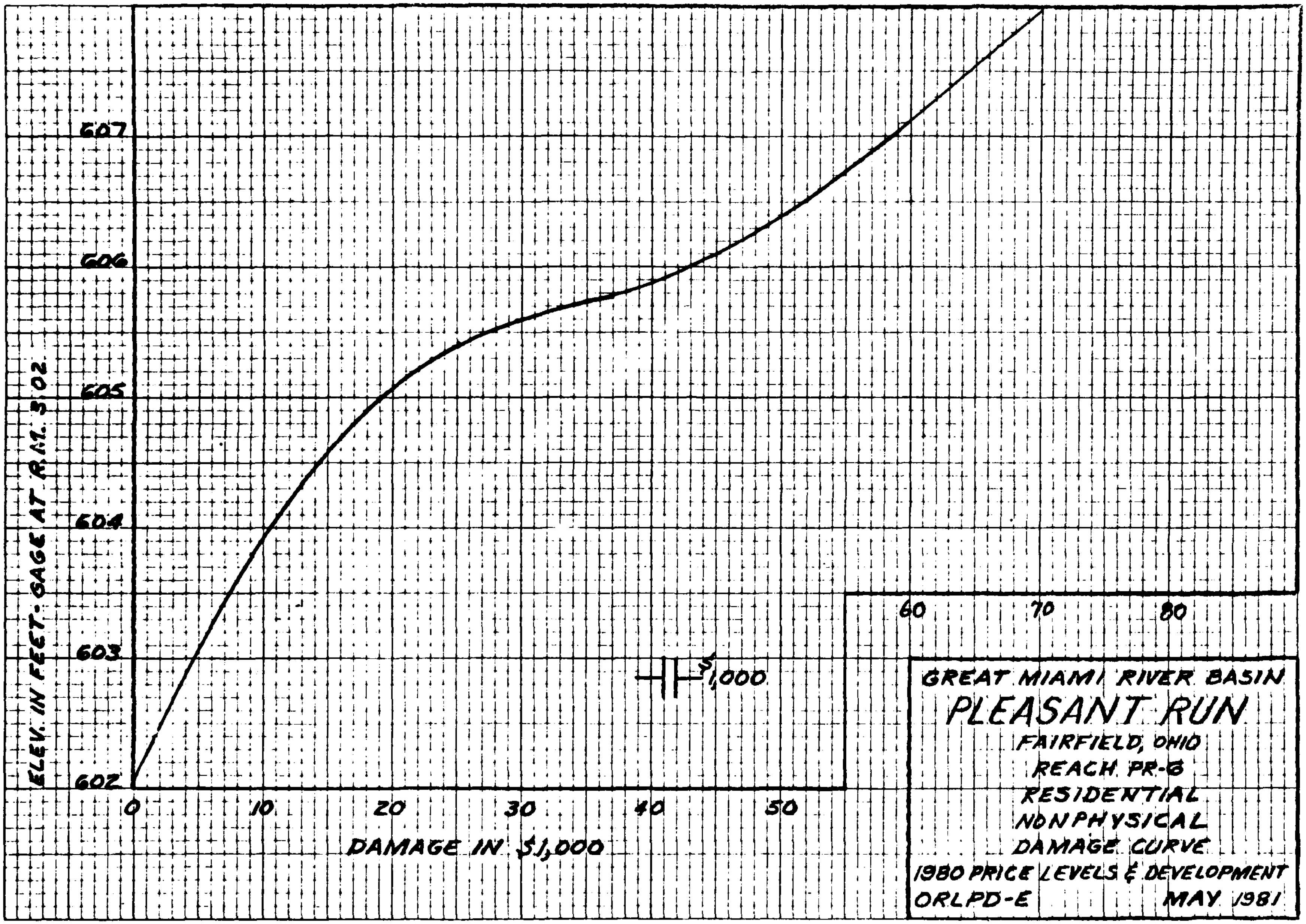

ELEV. IN FEET - GAGE AT R.M. 3.02
602
603
604
605
606
607
0
10
20
30
40
50
60
70
80
DAMAGE IN $1,000
$1,000
GREAT MIAMI RIVER BASIN
PLEASANT RUN
FAIRFIELD, OHIO
REACH PR-3
RESIDENTIAL
NONPHYSICAL
DAMAGE CURVE
1980 PRICE LEVELS & DEVELOPMENT
ORLPD-E
MAY 1981

PLATE E-3

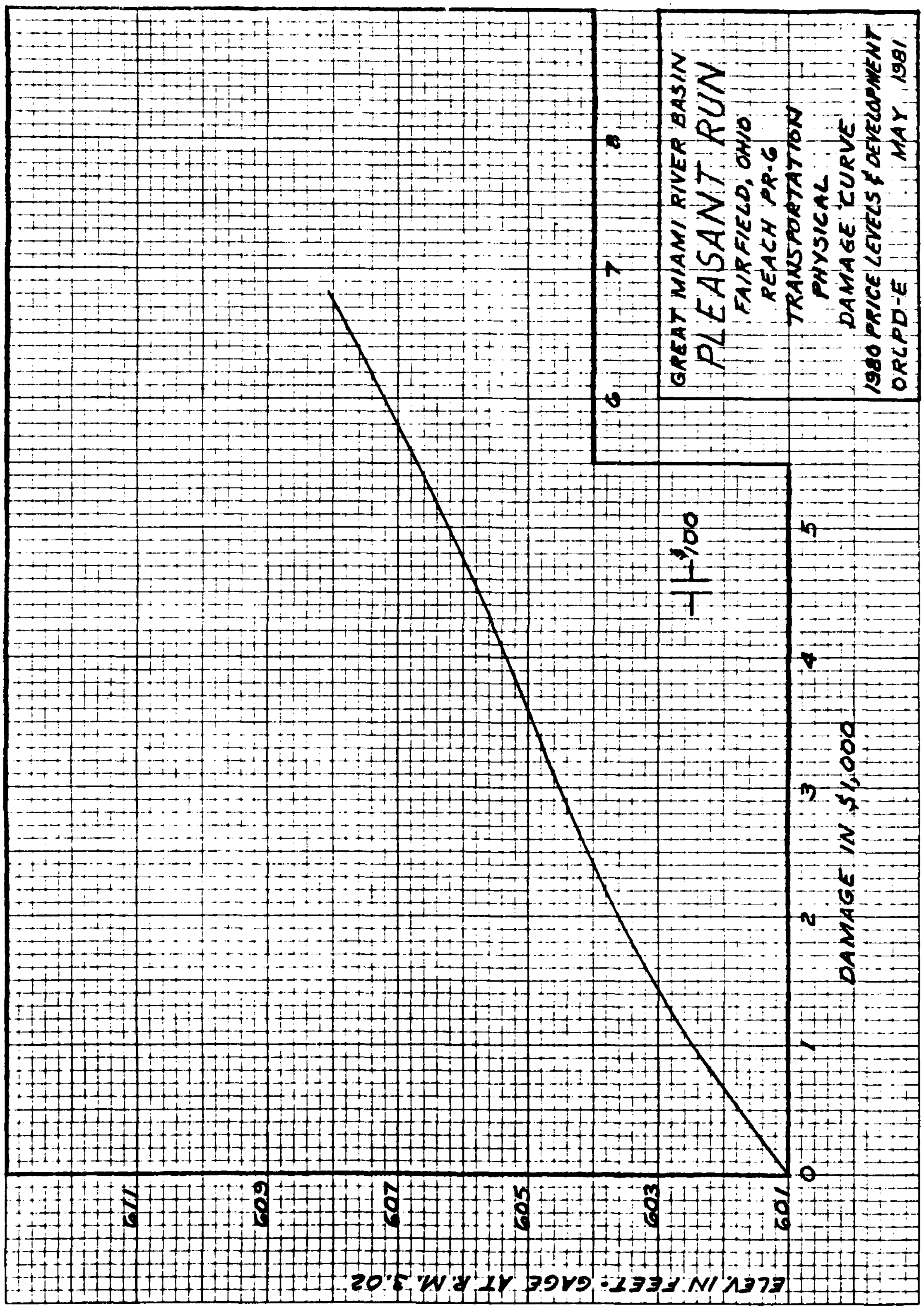
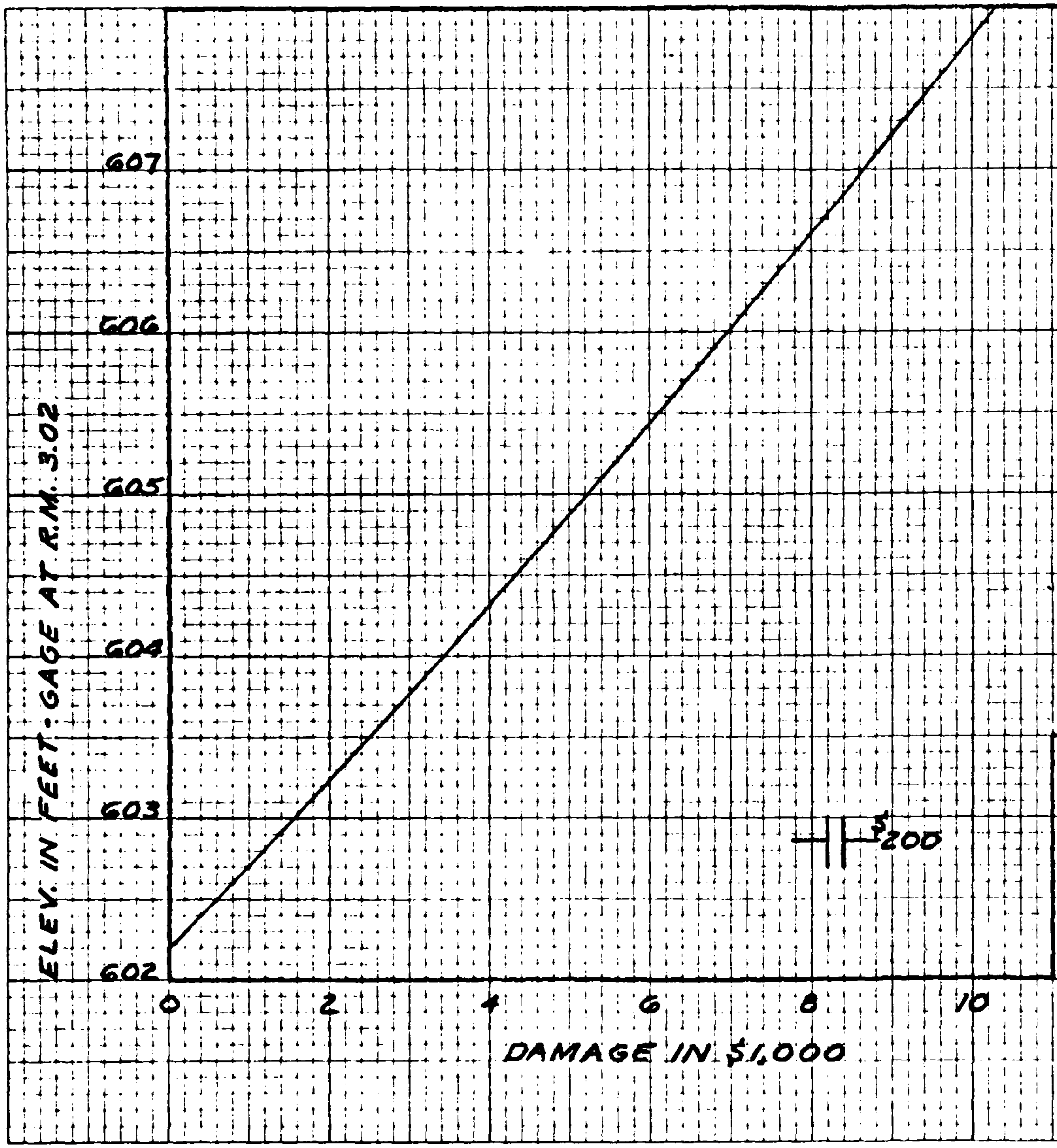

GREAT MIAMI RIVER BASIN
PLEASANT RUN
FAIRFIELD, OHIO
REACH PR-6
TRANSPORTATION
PHYSICAL
DAMAGE CURVE
1980 PRICE LEVELS & DEVELOPMENT
ORLPD-E MAY 1981
$100
DAMAGE IN $1,000
0
1
2
3
4
5
6
7
8
ELEV. IN FEET - GAGE AT R.M. 3.02
601
603
605
607
609
611

PLATE E-4



GREAT MIAMI RIVER BASIN
PLEASANT RUN
FAIRFIELD, OHIO
REACH PR-6

TRAFFIC DIVERSION
COST CURVE
1980 PRICE LEVELS & DEVELOPMENT

ORLPD-E MAY 1981

PLATE E-5

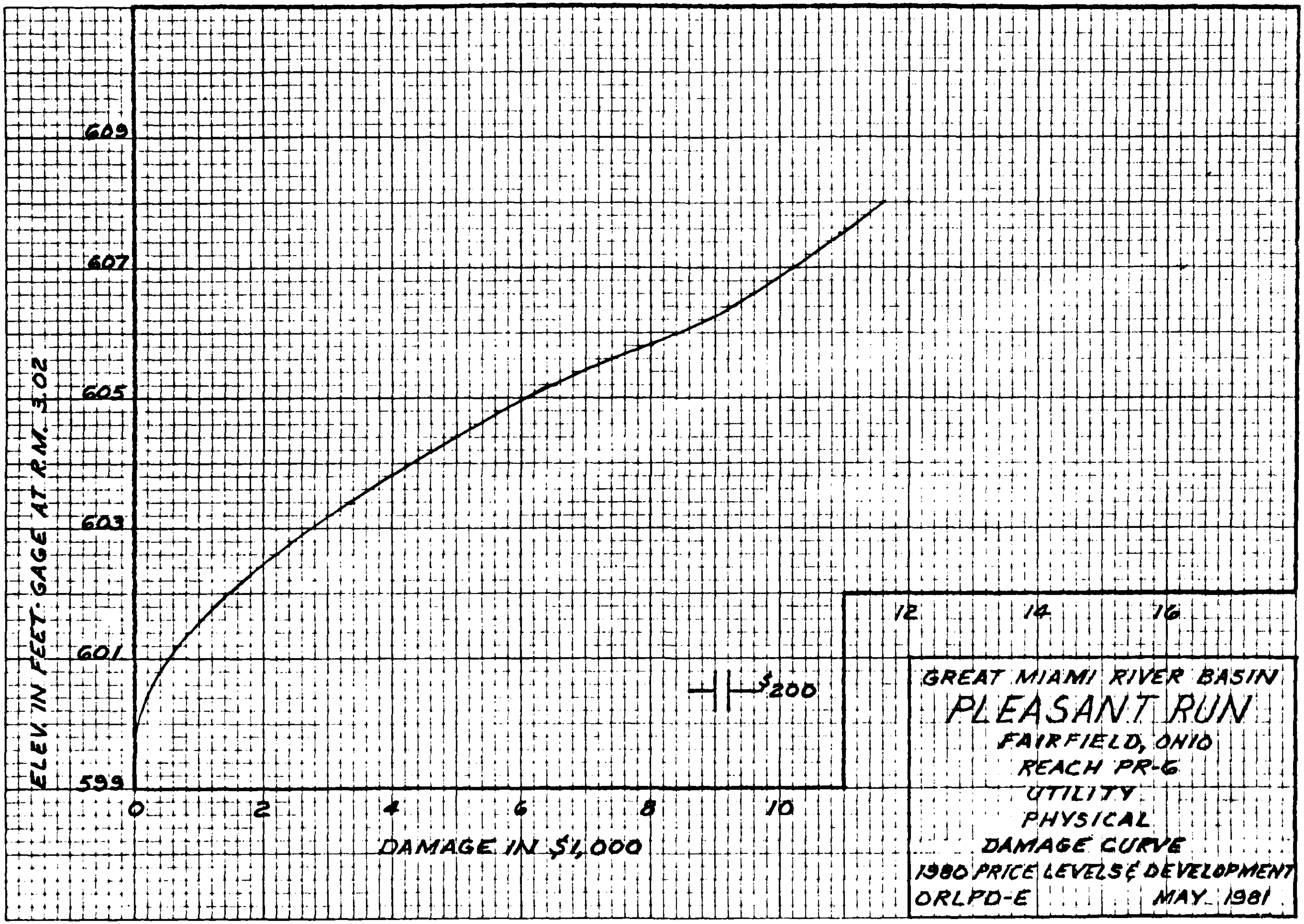
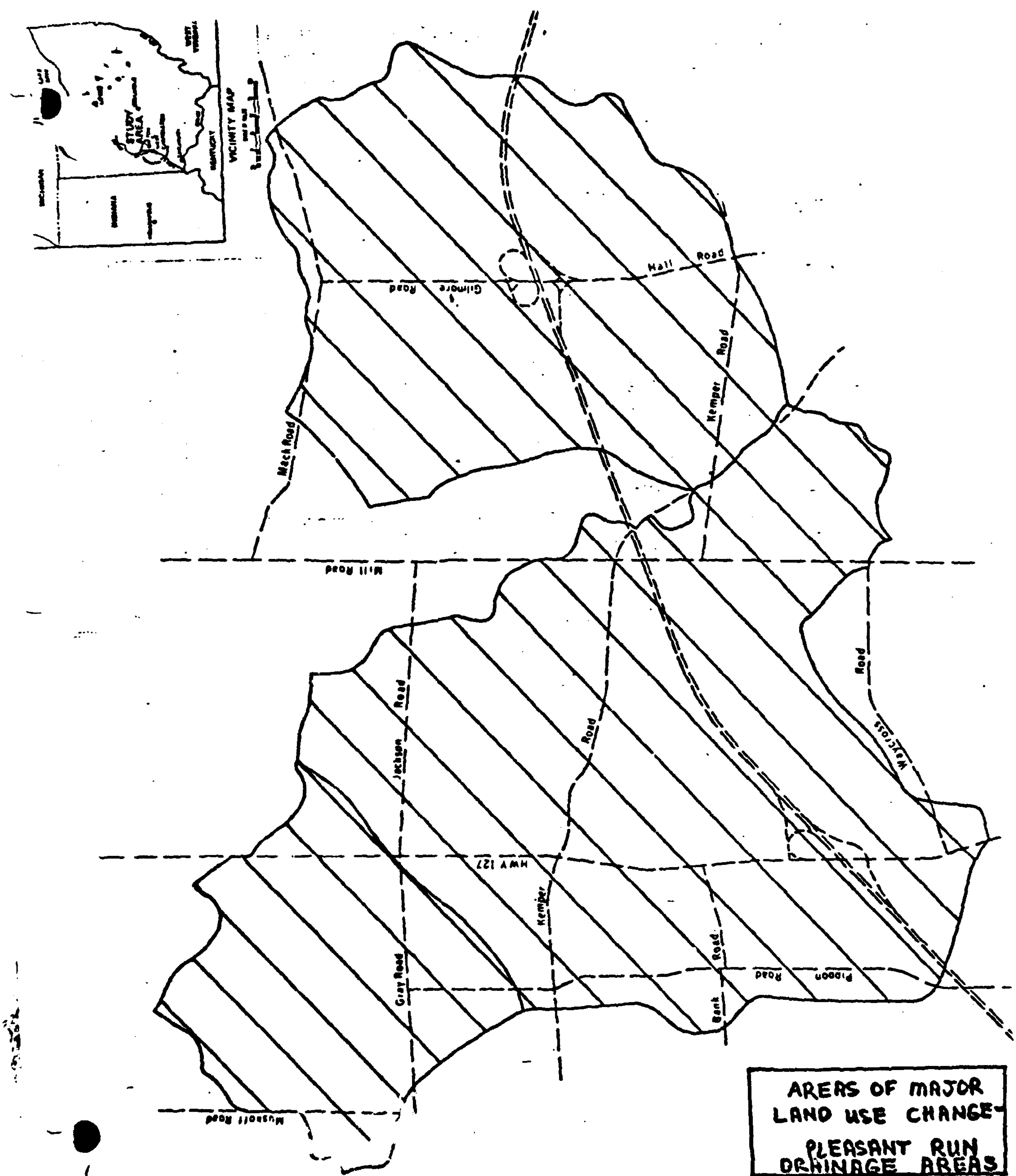

ELEV. IN FEET-GAGE AT R.M. 3.02
609
607
605
603
601
599
0
2
4
6
8
10
12
14
16
DAMAGE IN $1,000
$200
GREAT MIAMI RIVER BASIN
PLEASANT RUN
FAIRFIELD, OHIO
REACH PR-6
UTILITY
PHYSICAL
DAMAGE CURVE
1980 PRICE LEVELS & DEVELOPMENT
ORLPD-E
MAY 1981

PLATE E-6



AREAS OF MAJOR LAND USE CHANGE-
PLEASANT RUN DRAINAGE AREAS

PLATE E-7

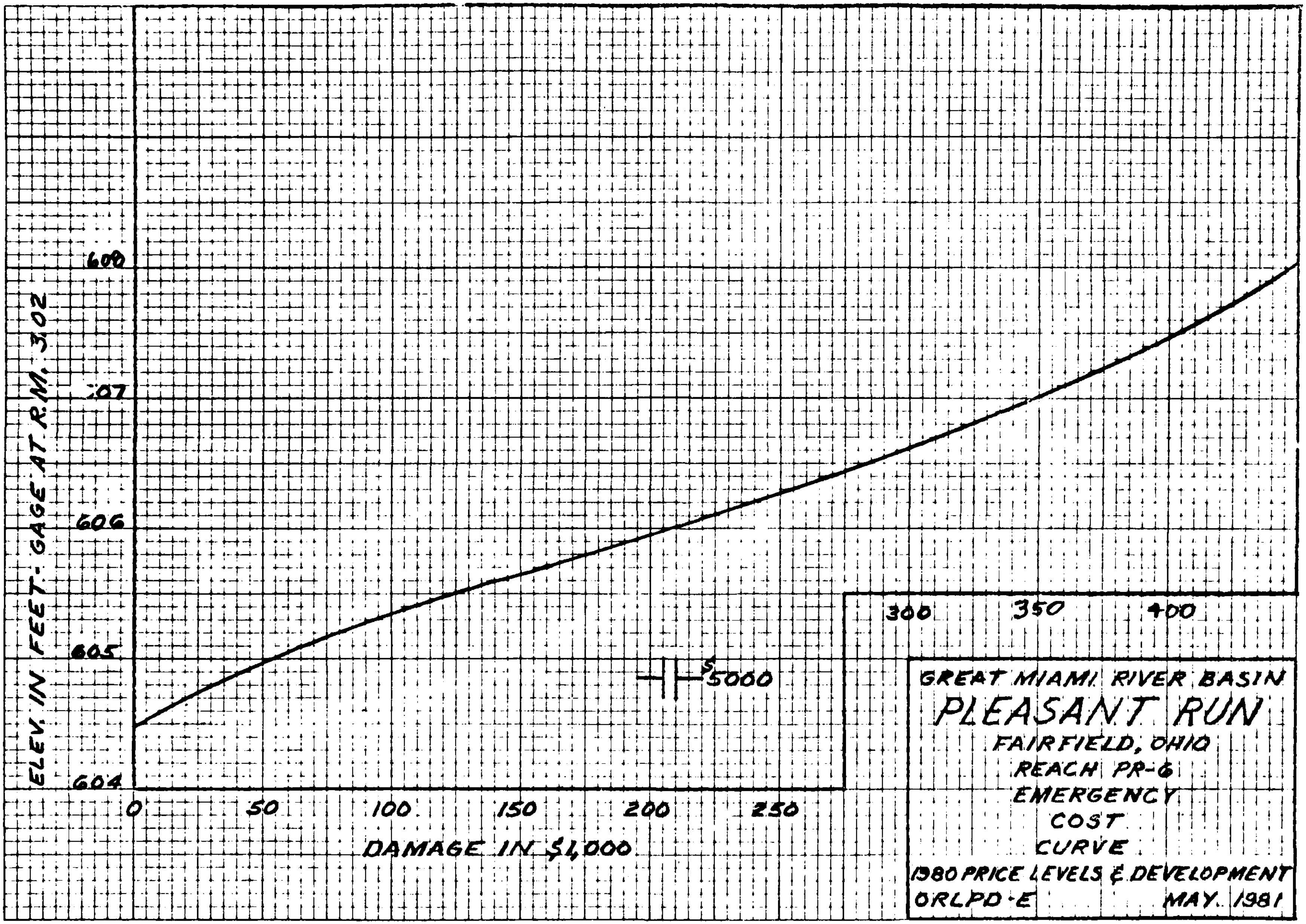
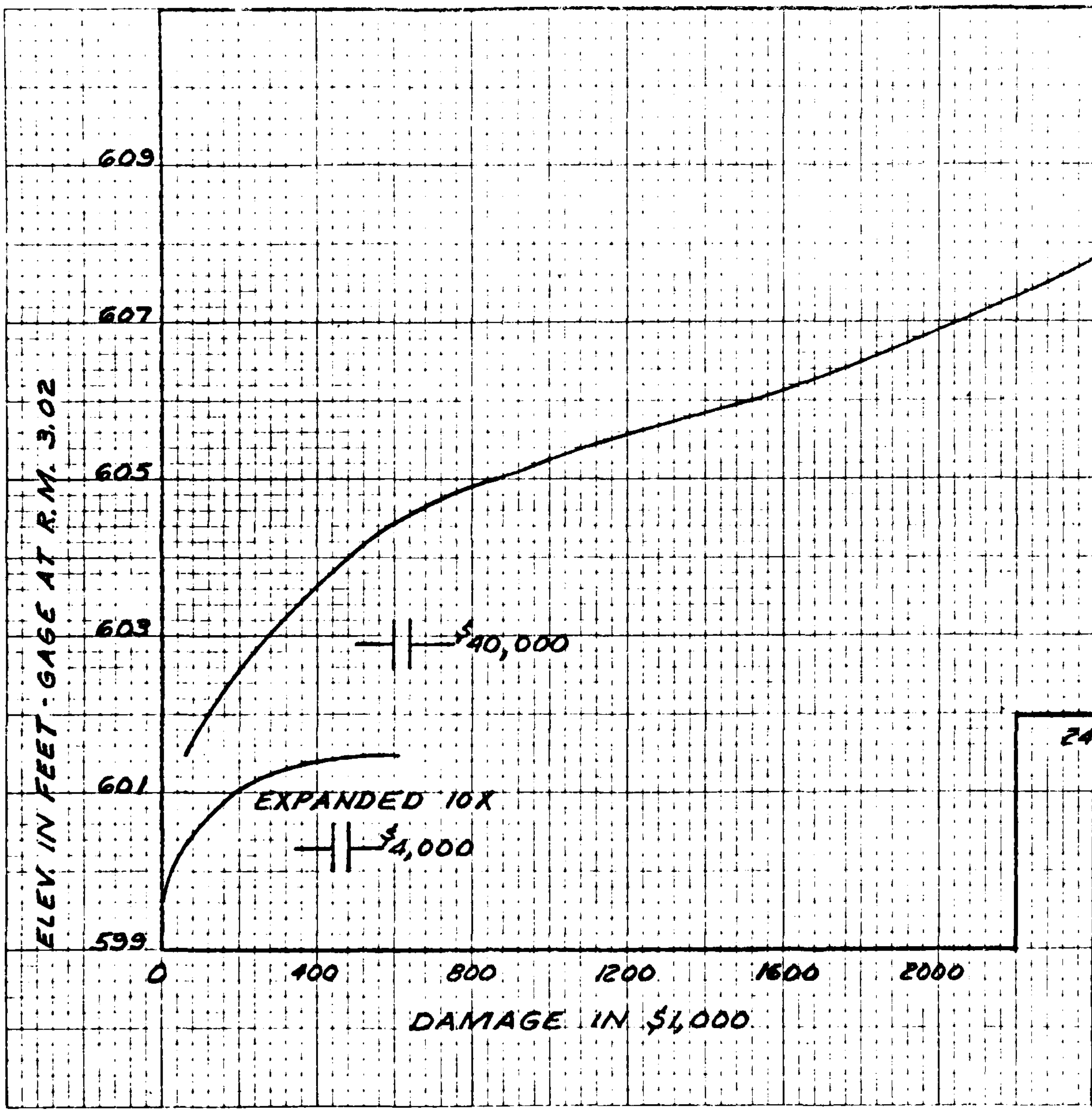

ELEV. IN FEET - GAGE AT R.M. 3.02
608
607
606
605
604
0
50
100
150
200
250
300
350
400
DAMAGE IN $1,000
$5000
GREAT MIAMI RIVER BASIN
PLEASANT RUN
FAIRFIELD, OHIO
REACH PR-6
EMERGENCY
COST
CURVE
1980 PRICE LEVELS & DEVELOPMENT
ORLPD-E
MAY. 1981

PLATE E-8



GREAT MIAMI RIVER BASIN
PLEASANT RUN
FAIRFIELD, OHIO
REACH PR-6
COMPOSITE
DAMAGE CURVE
1980 PRICE LEVELS & DEVELOPMENT
ORLPD-E MAY 1981

PLATE E-9

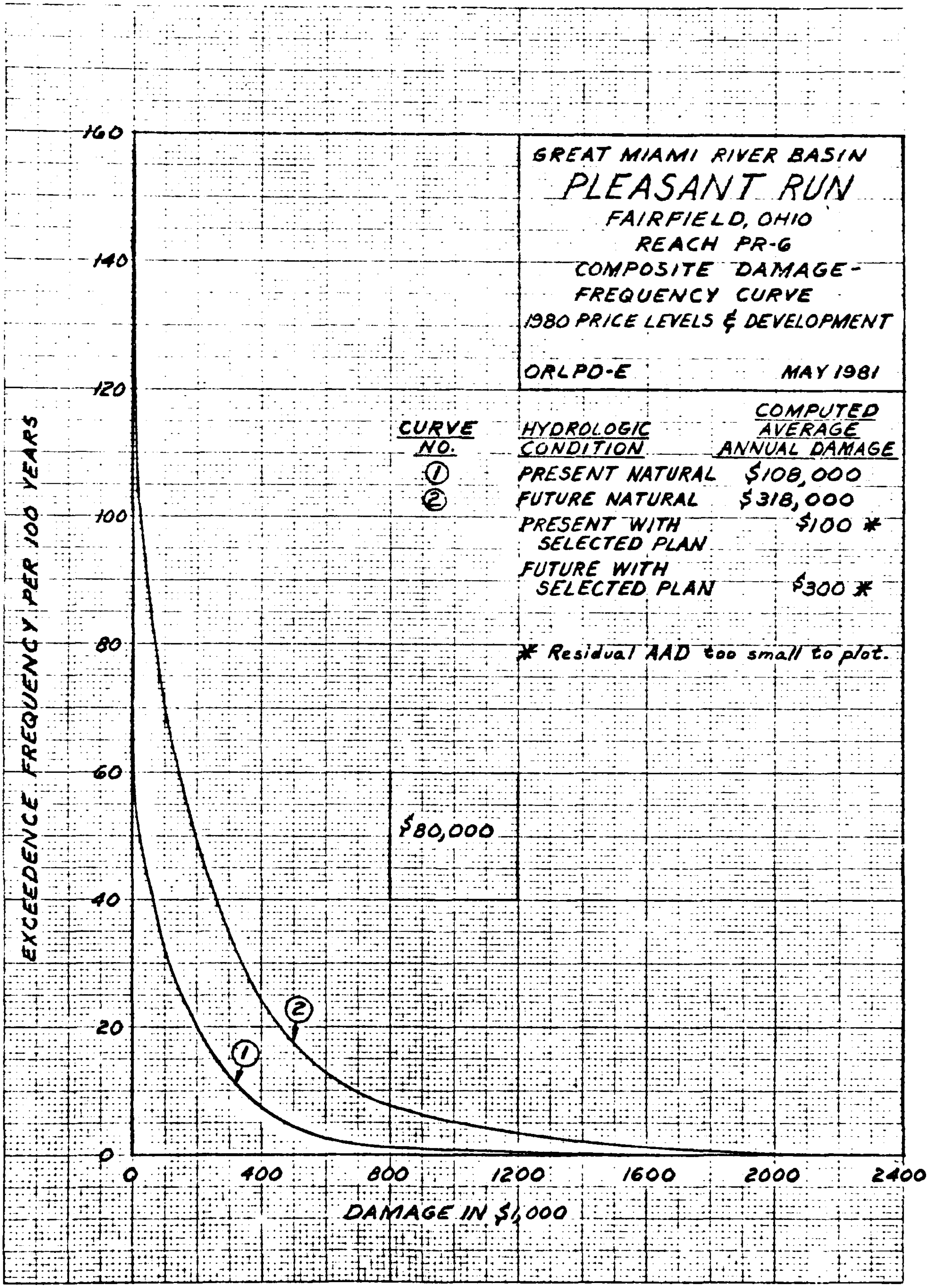
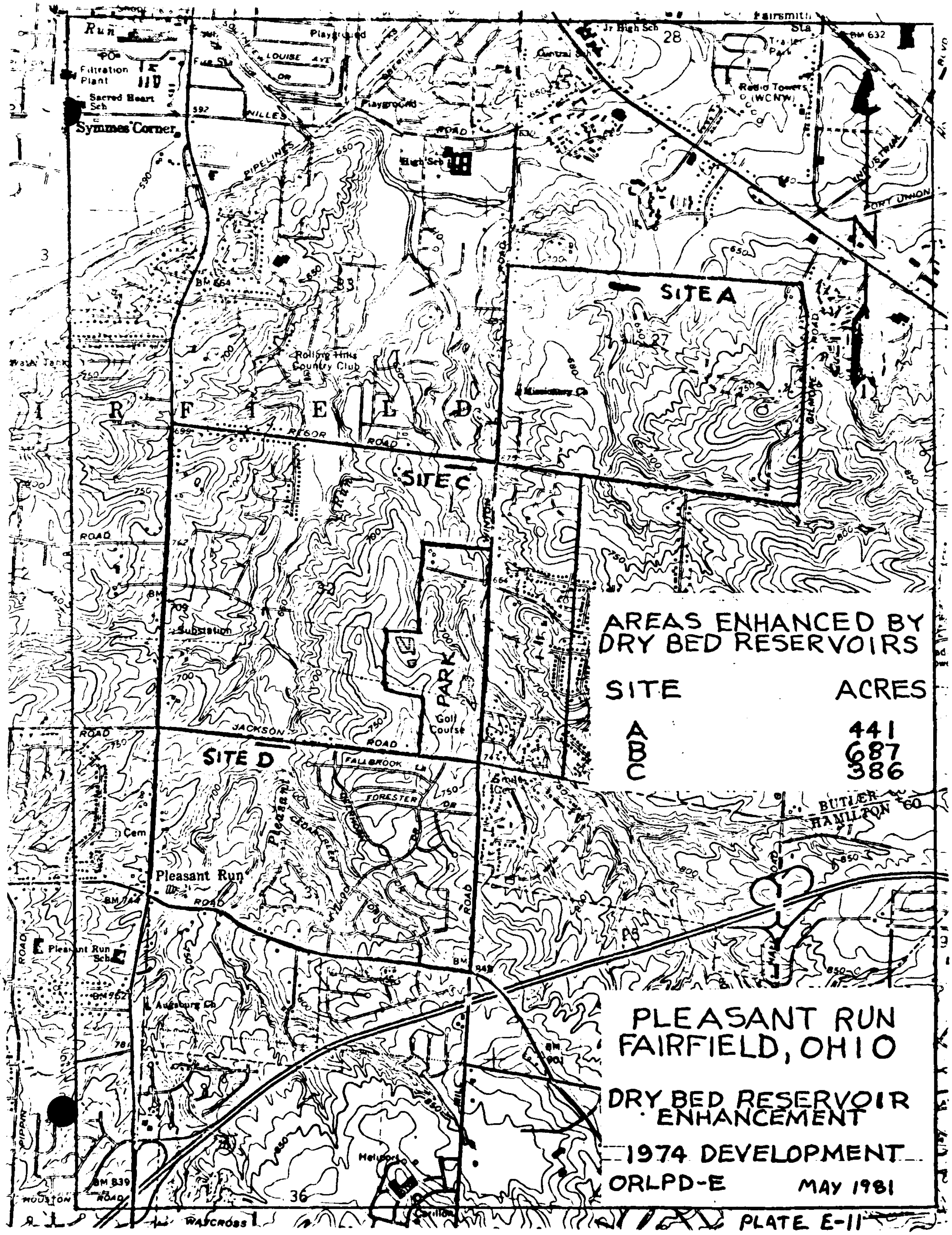

GREAT MIAMI RIVER BASIN
PLEASANT RUN
FAIRFIELD, OHIO
REACH PR-6
COMPOSITE DAMAGE-FREQUENCY CURVE
1980 PRICE LEVELS & DEVELOPMENT
ORLPD-E
MAY 1981
CURVE NO.
HYDROLOGIC CONDITION
COMPUTED AVERAGE ANNUAL DAMAGE
1
PRESENT NATURAL
$108,000
2
FUTURE NATURAL
$318,000
PRESENT WITH SELECTED PLAN
$100 *
FUTURE WITH SELECTED PLAN
$300 *
* Residual AAD too small to plot.
$80,000
EXCEEDENCE FREQUENCY PER 100 YEARS
DAMAGE IN $1,000
0
20
40
60
80
100
120
140
160
400
800
1200
1600
2000
2400

PLATE E-10



AREAS ENHANCED BY DRY BED RESERVOIRS
SITE ACRES
A 441
B 687
C 386
PLEASANT RUN
FAIRFIELD, OHIO
DRY BED RESERVOIR ENHANCEMENT
1974 DEVELOPMENT
ORLPD-E
MAY 1981
SITE A
SITE C
SITE D
Symmes Corner
Filtration Plant
Sacred Heart Sch
High Sch
Jr High Sch
Central Sch
Radio Towers (WCNW)
Rolling Hills Country Club
Substation
Golf Course
PARK
Pleasant Run
Pleasant Run Sch
Augsburg Ch
Cem
RESOR ROAD
JACKSON ROAD
FALLBROOK LN
FORESTER DR
BUTLER HAMILTON
PORT UNION
GILMORE ROAD
WATCROSS
HOUSTON ROAD
Heliport
Carillon

PLATE E-11

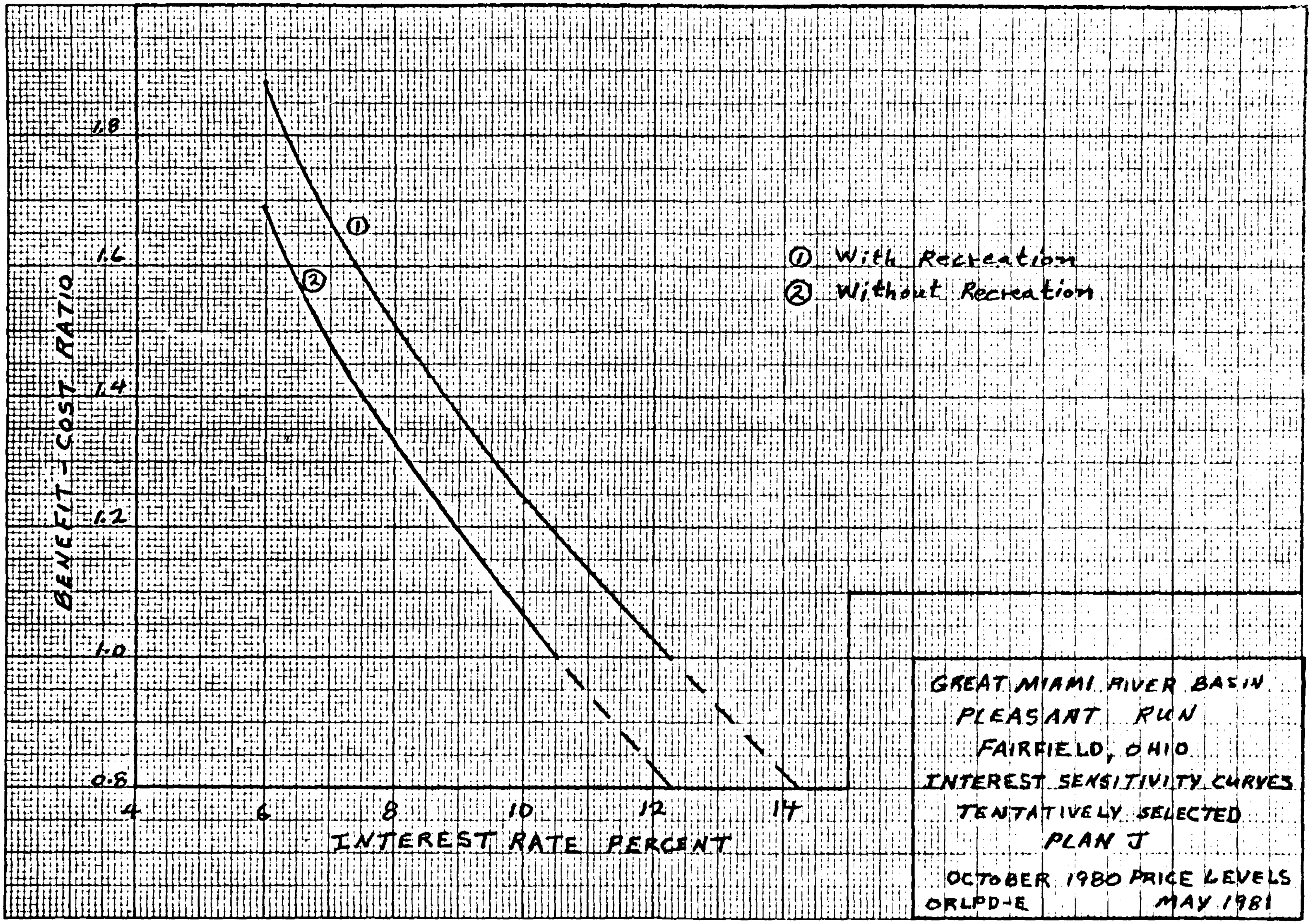

BENEFIT - COST RATIO
1.8
1.6
1.4
1.2
1.0
0.8
4
6
8
10
12
14
INTEREST RATE PERCENT
① With Recreation
② Without Recreation
GREAT MIAMI RIVER BASIN
PLEASANT RUN
FAIRFIELD, OHIO
INTEREST SENSITIVITY CURVES
TENTATIVELY SELECTED
PLAN J
OCTOBER 1980 PRICE LEVELS
ORLPD-E
MAY 1981

PLATE E-12

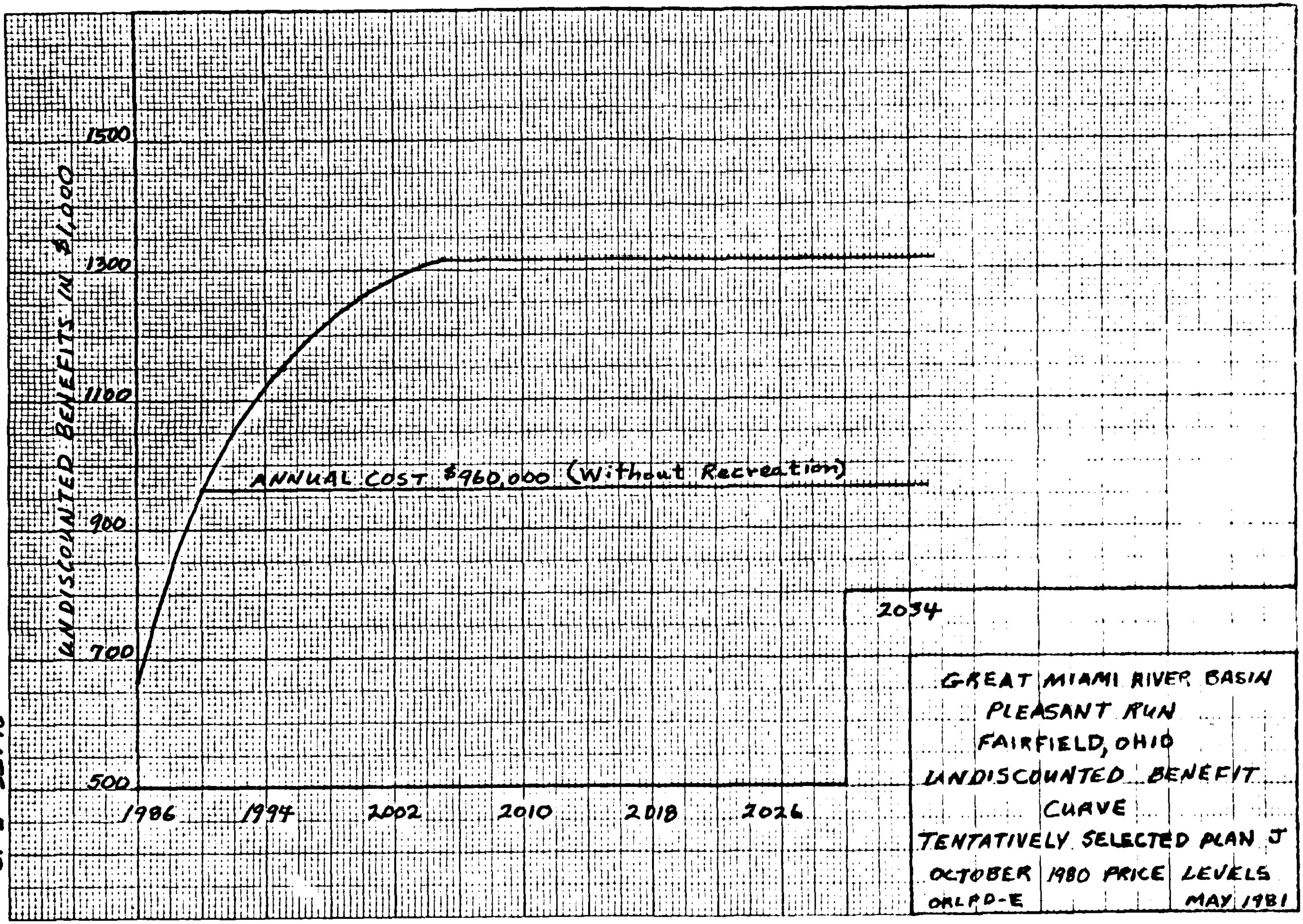
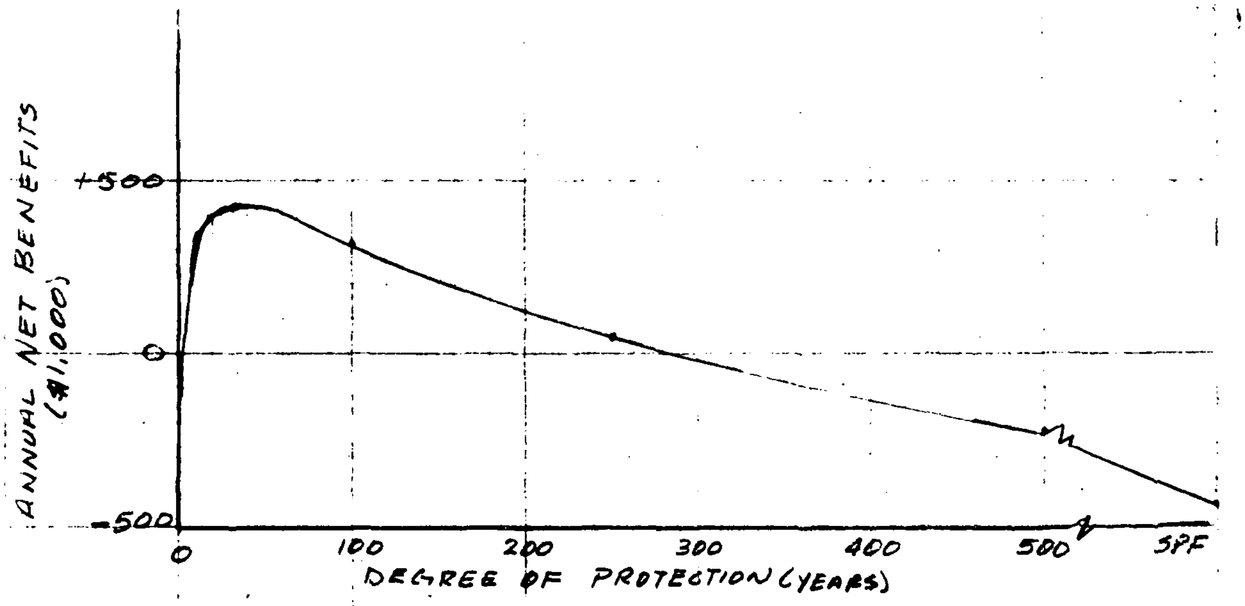

UNDISCOUNTED BENEFITS IN $1,000
1500
1300
1100
900
700
500
1986
1994
2002
2010
2018
2026
2034
ANNUAL COST $960,000 (Without Recreation)
GREAT MIAMI RIVER BASIN
PLEASANT RUN
FAIRFIELD, OHIO
UNDISCOUNTED BENEFIT
CURVE
TENTATIVELY SELECTED PLAN J
OCTOBER 1980 PRICE LEVELS
ORLPD-E
MAY 1981

PLATE E-13



FAIRFIELD, OHIO

3-DRY BED RESERVOIRS WITH CHANNEL ENLARGEMENT

NET BENEFIT MAXIMIZATION CURVE

JULY 1981

PLATE E-14

APPENDIX F

RECREATION RESOURCES

APPENDIX F

RECREATION RESOURCES

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RECREATION RESOURCES

AUTHORITY

The authority for inclusion of recreation in local flood control projects is contained in Section 4 of the Flood Control Act of 1944, as amended, and the Federal Water Projects Recreation Act 1965 (PL 89-72).

PURPOSE AND SCOPE

The purpose of this appendix is to give additional details on the recreation program recommended as a part of the Fairfield, Ohio Local Protection Project. This appendix limits itself to those issues impacting preauthorization planning. Further study that may be occasioned by authorization of this project will be more comprehensive. The recreation facilities were integrated with the flood control components and features after alternatives were torumulated and scoped for the flood control function.

Local Cooperation

The Miami Conservancy District has indicated their willingness to participate in recreational development of the flood control project. The District or other local agencies cooperating with them will be required by the cited law to provide all real estate for the project. Local interest will be required to provide at least 50 percent of the specific recreation facilities costs.

DESCRIPTION OF PROJECTS STUDIED

The following projects have been studied with regard to recreation.

PLAN H

Three dry bed reservoirs on Pleasant Run Creek and its tributaries with modification to 0.83 mile of the channel will provide flood protection at the 35-year protection level. These three reservoirs designated "A," "C," and "D" require the purchase of 31 acres, 64 acres, and 45 acres, respectively, most of which will be available for public use.

PLAN I

Three dry bed reservoirs with nonstructural measures to reach the level of 100-year protection is designated the nonstructural plan. In addition to the acreage available at the reservoir sites, limited recreation is available as part of evacuation and relocation of the structures.

PLAN J

The three reservoirs with channel work of about 1.37 miles constitute the 100-year protection plan. Recreation is available at each dry bed reservoir site, the same as for Plan H.

PLAN K

The all channel plan providing 35-year protection requires channel deepening and widening over a length of 2.92 miles. Trail development with staging areas in the severanced areas is studied in conjunction with this plan.

RESOURCES OF THE PROJECT AREA

GENERAL

The City of Fairfield is located in Butler County in the Cincinnati metropolitan area. During the last 20 years, the City has been rapidly

increasing in population as new houses have been built in subdivisions of former agricultural land. Although the community is primarilv one of single family houses, recent development includes multi-family structures. It is anticipated that the trend toward greater density of population will increase in the future as available land becomes scarce.

PHYSICAL FEATURES

Fairfield is located in the Till Plains region of Ohio. Topography is generally gentle to moderate with steep slopes located only along drainage ways. Natural vegetation is also generally confined to the few steep slopes in the region or to low lands which are too wet to farm.

RECREATIONAL RESOURCES

The Cincinnati metropolitan area has many parks and recreation areas. They are managed by many different federal, state and local agencies (see Figure F-1).

The following is a list of major parks within 10 miles of Fairfield:

Miami Erie Canal Park - Butler County Park District
Mount Airy Forest - City of Cincinnati
Sharon Woods - Hamilton County Park District
Winton Woods - West Fork Lake Hamilton County Park District

FACILITIES PRESENTLY AVAILABLE

The City of Fairfield has a very active Department of Parks and Recreation which presently manages 12 parks with a total of 366 acres. Ten of the parks are developed and two are undeveloped. Figure F-1 shows the facilities that have been developed.

PARKS AND RECREATION AREAS

CITY OF FAIRFIELD

Facility	William Harbin Municipal Park	Pleasant Run Recreation Center	Dravo Recreation Area	Waterworks Park	Good Neighbors Park	Lions Park	Winton Hills Park	River Road Playfields*	Governor's Tot Lot	Triangle Park	Oakwood Estates Park*	Gilbert Farms Park*
Acres	161	118	20	10	4	3	10	10	1/4	1/4	13	16
Nature Trails	X											
Fitness Trail	X											
Soccer/ Football Fields				X	X	X		X				
Shelter Houses	X		X	X	X	X	X					
Picnic Facilities	X		X	X	X	X	X			X		
Sanitary Latrines	X	X										
Playground Equipment	X			X	X	X	X		X			
Tennis Courts		X		X	X	X	X					
Basketball Courts				X	X	X	X					
Volleyball	X			X								
Swimming Pool		X										
Snack Bar		X										
18 Hole Golf Course		X										
Ball Diamonds	X			X	X	X	X					
Sledding Hill	X											
Fishing	X		X									
Scenic Overlook	X											

* Undeveloped

FIGURE F-1

POPULATION

The 1980 population of Butler County is estimated to be 258,380 and the estimate for Hamilton County is 873,136. It is estimated that Butler County will grow to 276,500 by 1990 and Hamilton County will decline in population to 838,700. Fairfield will increase from 30,816 in 1980 to 43,000 by 1990.

PUBLIC USE

Recreation Needs

The Ohio, Kentucky and Indiana Regional Planning Authority produced an "Open Space Plan" in 1973 which generally covers the Metropolitan Area of Cincinnati. This plan estimates that by 1990 Butler County will need approximately 2,000 acres of additional land as open space. Hamilton County will need 6,300 additional acres. With these large needs any help this region can receive towards meeting their goals will be well used.

Fairfield has been one of the fastest growing communities in the State of Ohio. In 1970 the population was 14,680 and in 1980 the population was 30,816. Although the growth trend is projected to slacken slightly, the 1990 population is estimated to be 43,000. The community has been well supplied with parks; however, needs have increased more rapidly than the supply of parks since land for development of parks is dwindling.

City Needs

Following is a tabulation of needs for the kind of activities which might be served on the lands acquired for the three dry-bed reservoirs. For the purposes of this computation the entire 1990 population of Fairfield is used as a base. Participation rates and numbers of days of participation are based on the 1970 Survey of Outdoor Recreation Activities by the Bureau of Outdoor Recreation.

Annual Activity	Population	Participation Rate	No. of Days Participation	Activity Days
Outdoor games	43,000	.39	45.1	756,000
Picnicking	43,000	.52	6.7	150,000
Walking/Jogging	43,000	.33	37.3	529,000
Bicycling	43,000	.23	48.6	481,000
				1,916,000

1,916,000 : 1.5 = Potential Recreation Days = 1,300,000 in 1990

For comparative purposes the same computation for 1970 in Fairfield would be 440,000 recreation days.

Activity	Population	Participation Rate	No. of Days Participation	Annual Activity Days
Outdoor games	14,680	.39	45.1	258,000
Picnicking	14,680	.52	6.7	51,000
Walking/Jogging	14,680	.33	37.3	181,000
Bicycling	14,680	.23	48.6	164,000
				654,000

654,000 : 1.5 = Recreation Days = 440,000 in 1970

Statewide Comprehensive Outdoor Recreation Plan (SCORP)

The 1980-1985 Ohio Statewide Comprehensive Outdoor Recreation Plan was considered to determine the types of recreation opportunities needed in the state and in Planning Region No. 1 which includes Fairfield. Table F-1, "1980 Statewide Participation and Facility Needs" is reproduced from Page 51 of the "Assessment and Policy Plan" of 1980-1985 SCORP.

TABLE F-1

1980 STATEWIDE PARTICIPATION AND FACILITY NEEDS

Activity	Household Participation Rate	Facility Needs	Percent Relative Need
Picnicking	.227	31,898 Tables	26
Swimming	.151	1,523,000 Sq Ft.	23
Baseball	.120	1,024 Diamonds	13
Camping	.085	37,245 Sites	40
Golf	.051	2,799 Holes	26
Football	.051	367 Fields	10
Basketball	.044	712 Goals	7
Fishing	.042	87,870 Acres	55
Tennis	.032	990 Courts	17
Boating	.023	85,105 Acres	54
Soccer	.018	455 Fields	36
Horseback Riding	.018	1,012 Miles	62
Hunting	.016	465,335 Acres	50
Canoeing	.008	585 Miles	65
Skiing	.008	67 Slopes	49
ORV (Off Road Vehicle) Riding	.003	170 Miles	68

In both the state as a whole and in Planning Region No. 1, the most needed facilities require either large amounts of land, a body of water, or a flowing stream. The lands being considered for acquisition as part of the proposed project are not of sufficient magnitude or isolation to provide for facilities for ORV riding, horseback riding, hunting, or camping. The topography is not suitable for downhill skiing. No permanent impoundment is proposed, and Pleasant Run has little flow at most times to accommodate canoeing, fishing, or boating.

The facilities proposed for development at the three retention reservoirs meet positive statewide needs for picnicking and outdoor sports facilities. It is noted that the 1980-1985 SCORP, unlike previous documents, does not attempt to quantify needs for hiking, and jogging, bicycle riding, play grounds, and winter sports other than skiing. It is just such neighborhood needs which can best be met at small projects skattered throughout suburban residential areas.

Positive needs for neighborhood and community facilities can be estimated through the rapid growth of Fairfield anticipated in the next 20 years and the active program of recreational development ongoing in the town.

ATTENDANCE

The estimate of attendance for the dry-bed reservoirs is based on carrying capacity of the proposed project lands and the high demands for neighborhood facilities in this part of Ohio. All activities that can be reasonably provided and can be included in Corps development at a local flood protection project are included in the estimate. Slightly different activities are shown for the three reservoir areas under consideration because of differences in the neighborhoods and the suitability of the natural resources.

When computing attendance by this method the following formula is used.

$$V_n = Un \times Cn \text{ where } U_n = \frac{A \times T_n \times N_n}{Y \times PWV}$$

where
V_n = Annual use by activity
A = Area or unit
C_n = Carrying capacity of unit
U_n = Use
T_n = Turnover for facility or area
N_n = Length of Season in weeks
Y = Percent of use in recreation season
PWV = Percent of weekly use on weekend day

The attendance in recreation days for the site is determined to be the sum of the V_n's divided by 1.5 which is the average number of activities engaged in by an individual.

Site "A" contains extremely attractive woodlands which can serve special recreational needs such as birdwatching and nature study. This

site also lends itself to outdoor sports, bicycling, walking, and other games. However, no item is used for jogging or sledding because these conflict to some extent with the quieter uses planned. See Plate F-1 for the facilities planned for this site.

Nature Study [1/]	Outdoor games	Walking
A = 10 acres	A = 8 acres	A = .6 miles
C = 1 person/acre	C = 30 people/acre	C = 40 people/mile
T = 3	T = 2	T = 5
N = 30	N = 30	N = 30
Y = .80	Y = .80	Y = .8
PWV = .30	PWV = .25	PWV = .25

Attendance

Nature Study $10 \times 1 \times \frac{3 \times 30}{.8 \times .3} =$ 3,700

Outdoor games $8 \times 30 \times \frac{2 \times 30}{.8 \times .25} =$ 72,000

Walking $\frac{.6 \times 40 \times 5 \times 30}{.8 \times .25} =$ 18,000

93,700

Recreation Days = 93,700 ÷ 1.5 = 60,000

1/ Includes approximately 1.4 miles of nature trails.

Site "C" is the largest area of the studied sites and is located near the city-operated 118-acre, Pleasant Run Recreation Area. For this reason a larger number of facilities are planned. Also the greater portion of open fields in the area are more suitable for active recreation. See Plate F-2 for the facilities planned for this site.

Outdoor games	Sledding
A = 10 acres	A = 4 acres
C = 30 people/acres	C = 25 people/acre
T = 2	T = 3
N = 30	N = 7
Y = .80	Y = .80
PWV = .25	PWV = .35

Picnicking	Jogging
A = 8 acres	A = 1.0 mile
C = 20 people/acre	C = 70 people/mile
T = 2	T = 5
N = 18	N = 30
Y = .80	Y = 80
PWV = .30	PWV = .25

Outdoor games $10 \times 30 \dfrac{2 \times 30}{.8 \times .25} = 90{,}000$

Sledding $4 \times 25 \dfrac{3 \times 7}{.8 \times .35} = 7{,}500$

Picnicking $8 \times 20 \dfrac{2 \times 18}{.8 \times .3} = 24{,}000$

Jogging $1 \times 70 \dfrac{5 \times 30}{.8 \times .25} = \underline{52{,}500}$

174,000

Recreation Days = 174,000 ÷ 1.5 = 120,000

Site "D" is located outside of Fairfield in Hamilton County. This site is also located within 0.5 mile of the Pleasant Run Recreation Area. Consequently it is anticipated that use of this site will be primarily from the neighborhood in which it is located. See Plate F-3 for the facilities planned for this site.

Sledding	Jogging	Outdoor Games
A = 4 acres	A = 1 mile	A = 7 acres
C = 25 people/acre	C = 70 people/mile	C = 30 people/acre
T = 3	T = 5	T = 2
N = 7	N = 30	N = 30
Y = .80	Y = .8	Y = .8
PWV = .35	PWV = .3	PWV = .25

Sledding $4 \times 25 \dfrac{3 \times 7}{.8 \times .35} = 7{,}500$

Jogging $1 \times 70 \, \frac{5 \times 30}{.8 \times .3} = 43,750$

Outdoor Games $7 \times 30 \, \frac{2 \times 30}{.8 \times .25} = \underline{63,000}$

114,250

Recreation Days = 114,250 : 1.5 = 75,000

For channel plan (Plan K) approximately 3 miles of trail can be developed along the channel work under consideration.

Biking	Jogging
A = 3 miles	A = 3 miles
C = 40 people/mile	C = 40 people/mile
T = 4	T = 5
N = 30	N = 30
Y = .80	Y = .80
PWV = .25	PWV = .25

Biking $3 \times 40 \, \frac{4 \times 30}{.80 \times .30} = 60,000$

Jogging $3 \times 40 \, \frac{5 \times 30}{.80 \times .25} = \underline{90,000}$

150,000

Recreation Days = 150,000 : 1.5 = 100,000

UNIT RECREATION DAY VALUE

The methodology published in the Federal Register, Vol. 44 No. 242, Friday, December 14, 1979, was used to determine the unit day value. The value is determined from rating the potential quality of the project against the established criteria. The "Recreation Experience" criteria is rated 7 from a possible 30 points. The reason for this rating is that although a number of activities will be accommodated, none will be provided with highly developed facilities. The "Availability of Opportunity" criteria receives a zero rating because of the general availability of other similar facilities in the area. This "Carrying Capacity" criteria is rated 4 from a possible 18 because the facilities will be intensively used. The "Accessibility" Criteria is rated 5 from a possible 18 because although there is a good local road network, no roads exist within the sites and with the exception of small entrance

roads and parking areas, access will be either by foot or bicycle. The "Environmental Quality" criteria is rated 7 from a possible 20 because of the very ordinary character of most of this area and the continuous urbanization of the area. The sum of the ratings is 23 which is closely corresponds to the value of $1.80 established in the "Conversion of Points to Dollar Values" revised December 14, 1979.

PROPOSED PLANS OF DEVELOPMENT

GENERAL

As components of the various plans, three dry-bed reservoirs are planned along with trail development along the channel in all channel development plans. Reservoir "A" is located between Crestview Drive on the east and Winton Road on the west. Part of the site, including the proposed borrow area is located on agricultural land. The remainder is situated in mature woods of unusually high environmental quality. Due to the nature of the project, there will be little effect on the woodland except at the damsite. The best use for the lands of this site is development of passive recreational features through the woodlands and utilization of the graded and restored borrow areas for game fields. The City of Fairfield already owns part of the ponding area. Generally, Site A can be developed with a short entrance road and small parking area for users who wish to drive to this site. A nature trail will promote use of this excellent woodlands, and bike trails can be developed to connect this site with others to be developed. A tot lot and other game facilities can be constructed on the borrow areas which can be landscaped to enhance their appearance.

Reservoir "C" is located at the southwest corner of Winton and Resor Roads. This site adjoins the city managed Pleasant Run Recreation Area and would probably be developed to enhance the existing project. This site is the most open of the proposed reservoir sites, having only a small amount of young second-growth trees in the bottom of the stream valley. The site will generally lend itself to development of game

fields and playgrounds on the graded borrow area and picnic facilities in the higher elevations of the ponding area.

Jogging and bicycle trails will complete the facilities for development of this area.

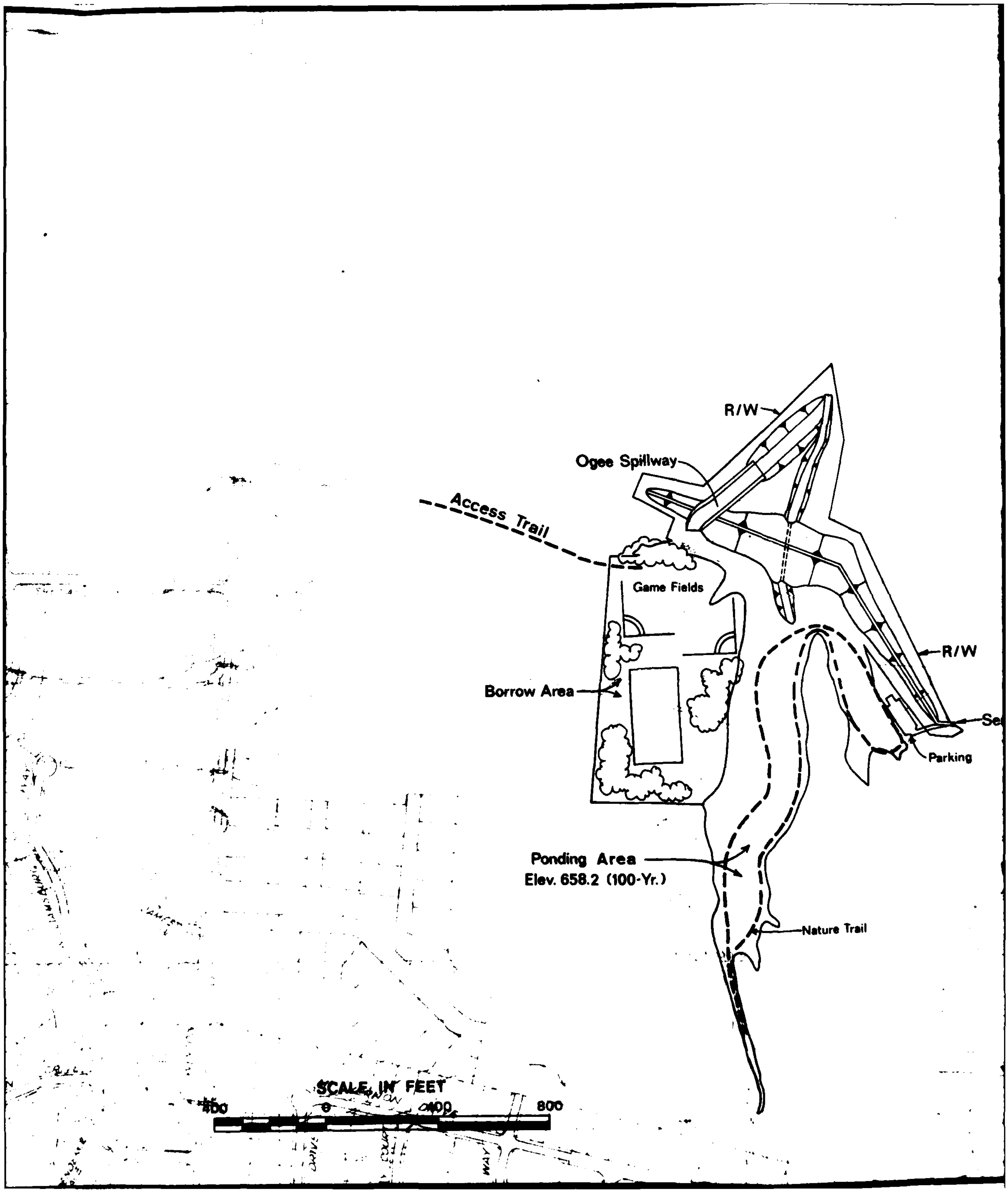
Reservoir "D" is located outside of the boundaries of both Fairfield and Butler County in Hamilton County. The dam is located on the south side of Jackson Road between Winton Road and U.S. Highway 127. To the east and south of the area are existing subdivisions which will be impacted to some extent by land acquisition. The land is generally open with a small stand of mature woods in the stream valley. The major portion of the borrow area will be excavated below the ponding elevation to allow for ponding storage during intense rainfall. The area will be graded and is of sufficient size to supply play fields for the neighboring area. A tot lot, jogging trail and connecting bicycle trails will be the extent of recreational development.

Channel-side trail development is proposed for the all-channel plan (Plan K). The trail will be developed on the 10 feet of maintenance right-of-way along the top of the bank throughout the length of the work which is about 2.92 miles, and follows Pleasant Run Creek. In many places, Pleasant Run flows between the backyards of houses set close to the creek. In these locations, the trail may have to avoid the creek bank and follow low use residential streets. In other areas, there will be sufficient room for the trail along the bank without limiting property owners privacy. A spoil area near the center of Fairfield could provide a staging area for the trail system. The tail will be tied into the existing bike trail system designated by Fairfield.

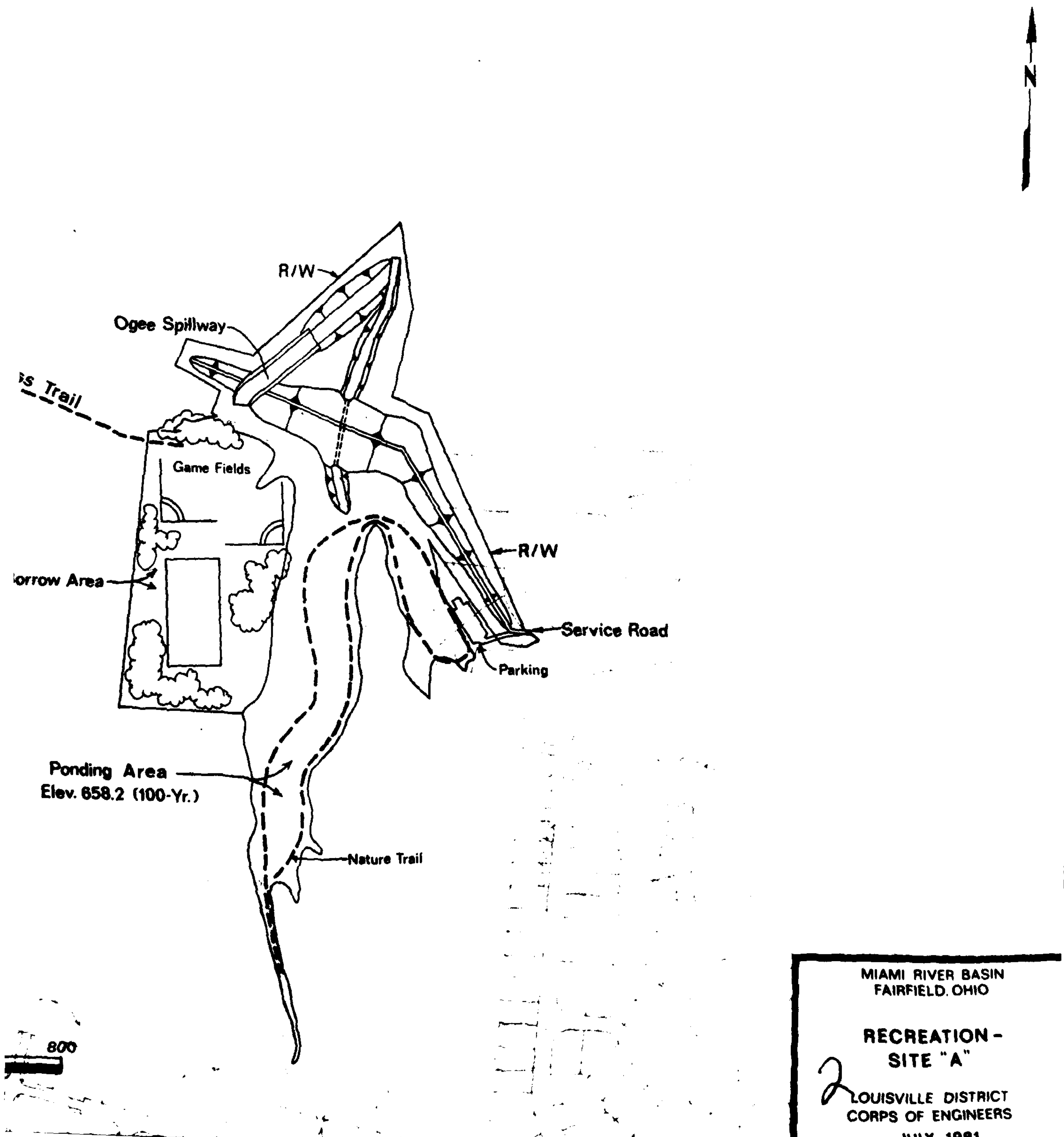
COST ESTIMATES

Table E-6 in Appendix E shows the costs for the facilities and lands described above. All prices are based on October 1980 price levels.

APPENDIX F
PLATES



R/W
Ogee Spillway
Access Trail
Game Fields
Borrow Area
R/W
Parking
Ponding Area
Elev. 658.2 (100-Yr.)
Nature Trail
SCALE IN FEET
400 0 400 800

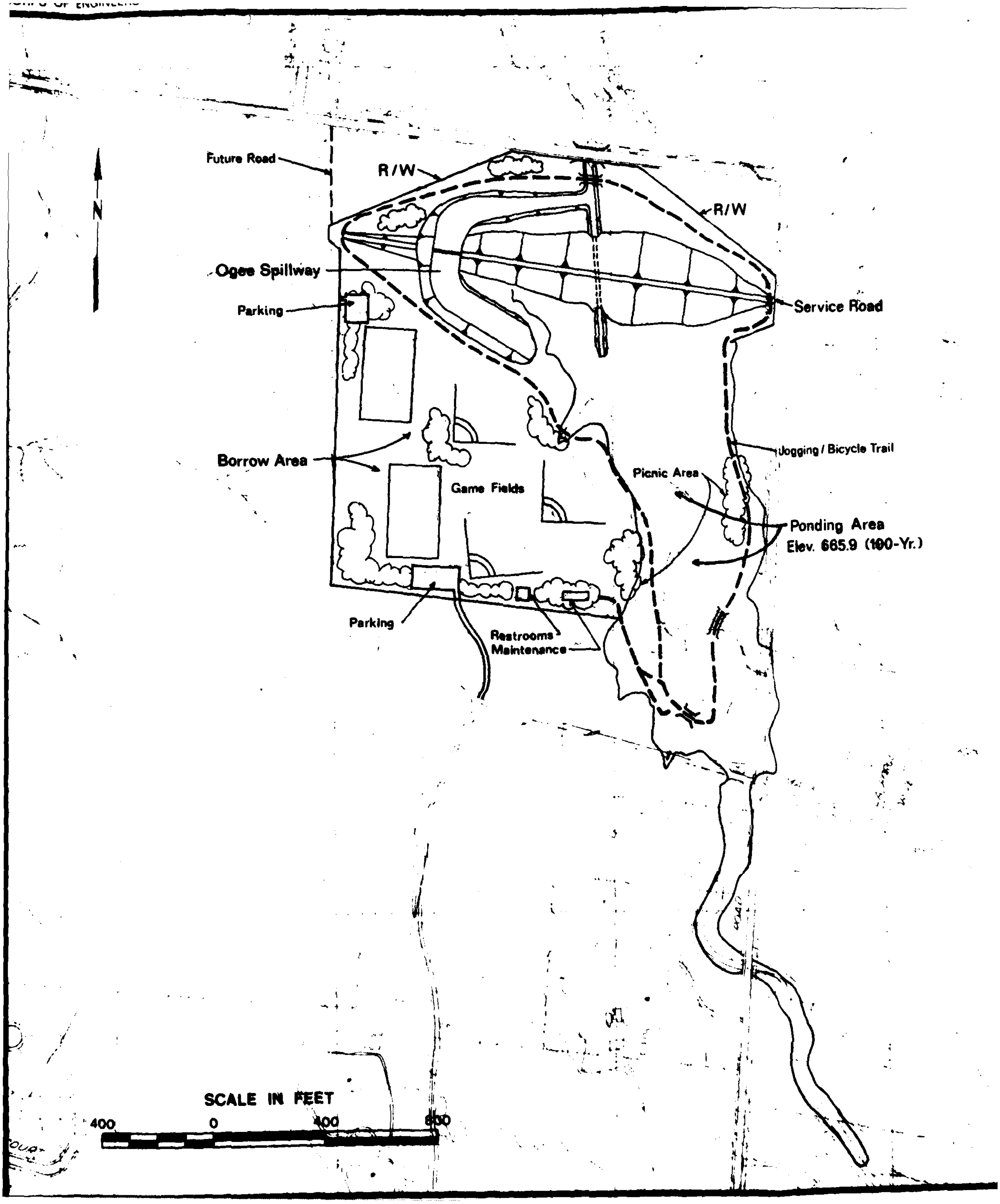


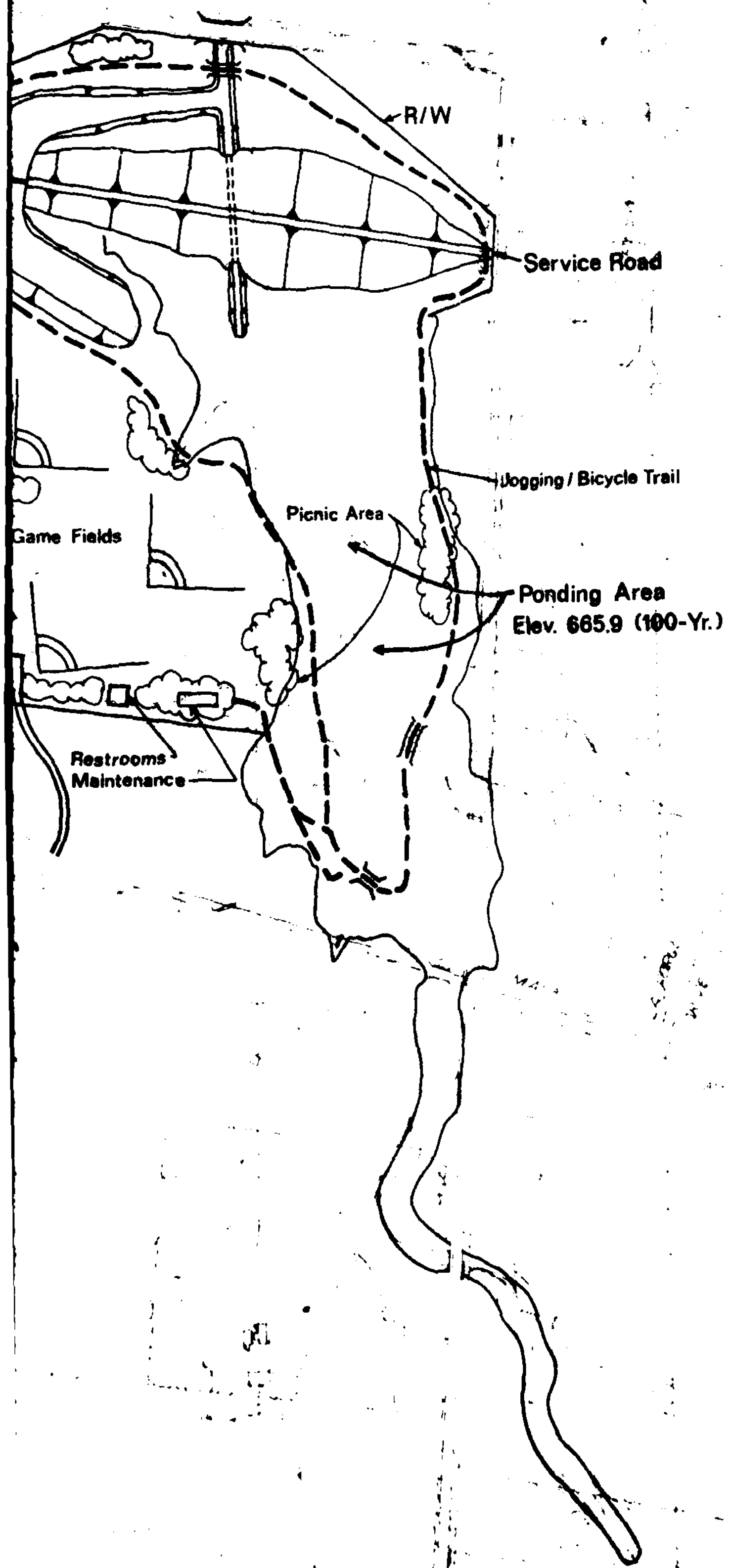
MIAMI RIVER BASIN
FAIRFIELD, OHIO

RECREATION -
SITE "A"

2

LOUISVILLE DISTRICT
CORPS OF ENGINEERS
JULY 1981


N
Future Road
R/W
R/W
Ogee Spillway
Parking
Service Road
Borrow Area
Game Fields
Jogging / Bicycle Trail
Picnic Area
Ponding Area
Elev. 665.9 (100-Yr.)
Parking
Restrooms
Maintenance
SCALE IN FEET
400 0 400 800

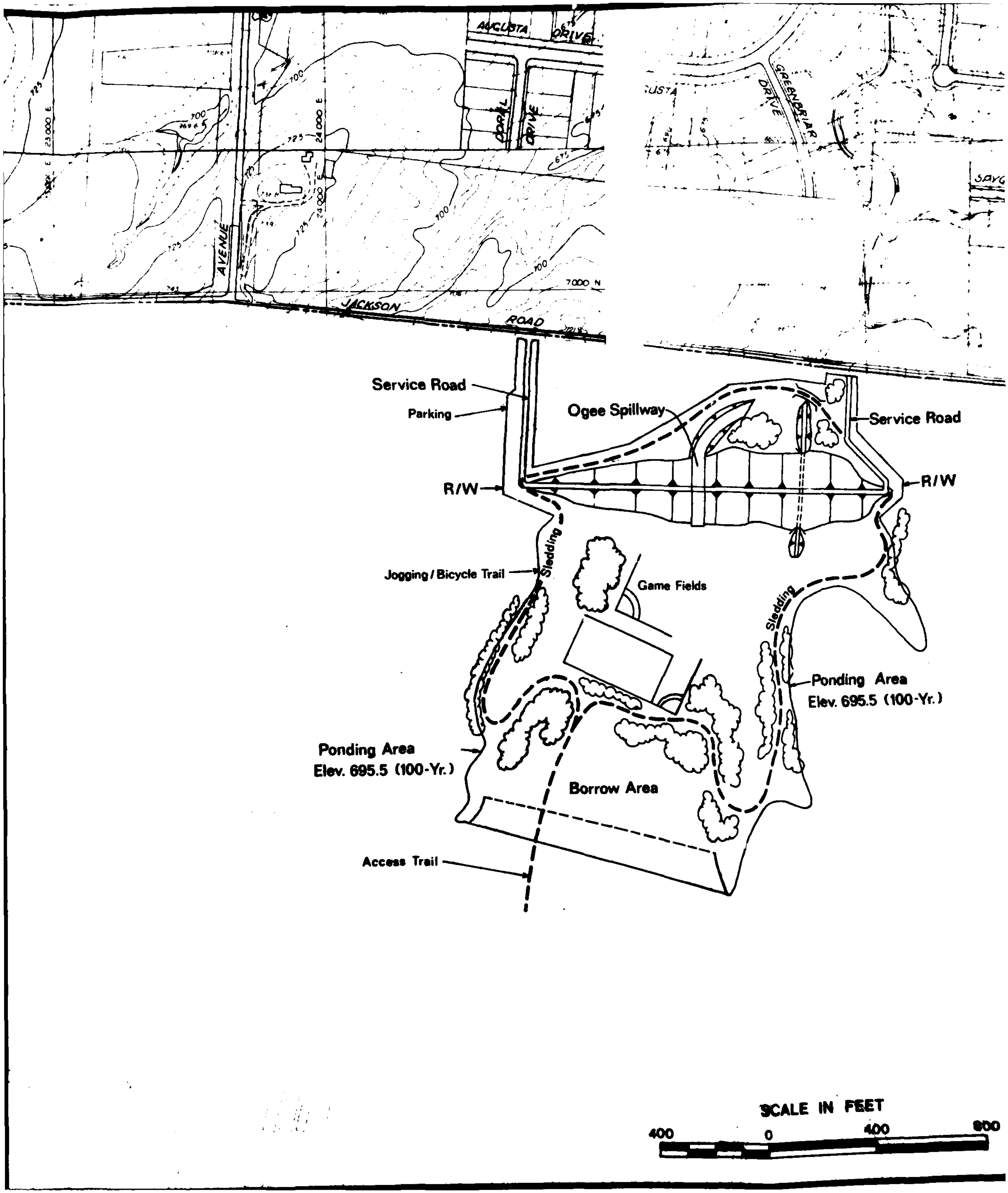


MIAMI RIVER BASIN
FAIRFIELD, OHIO

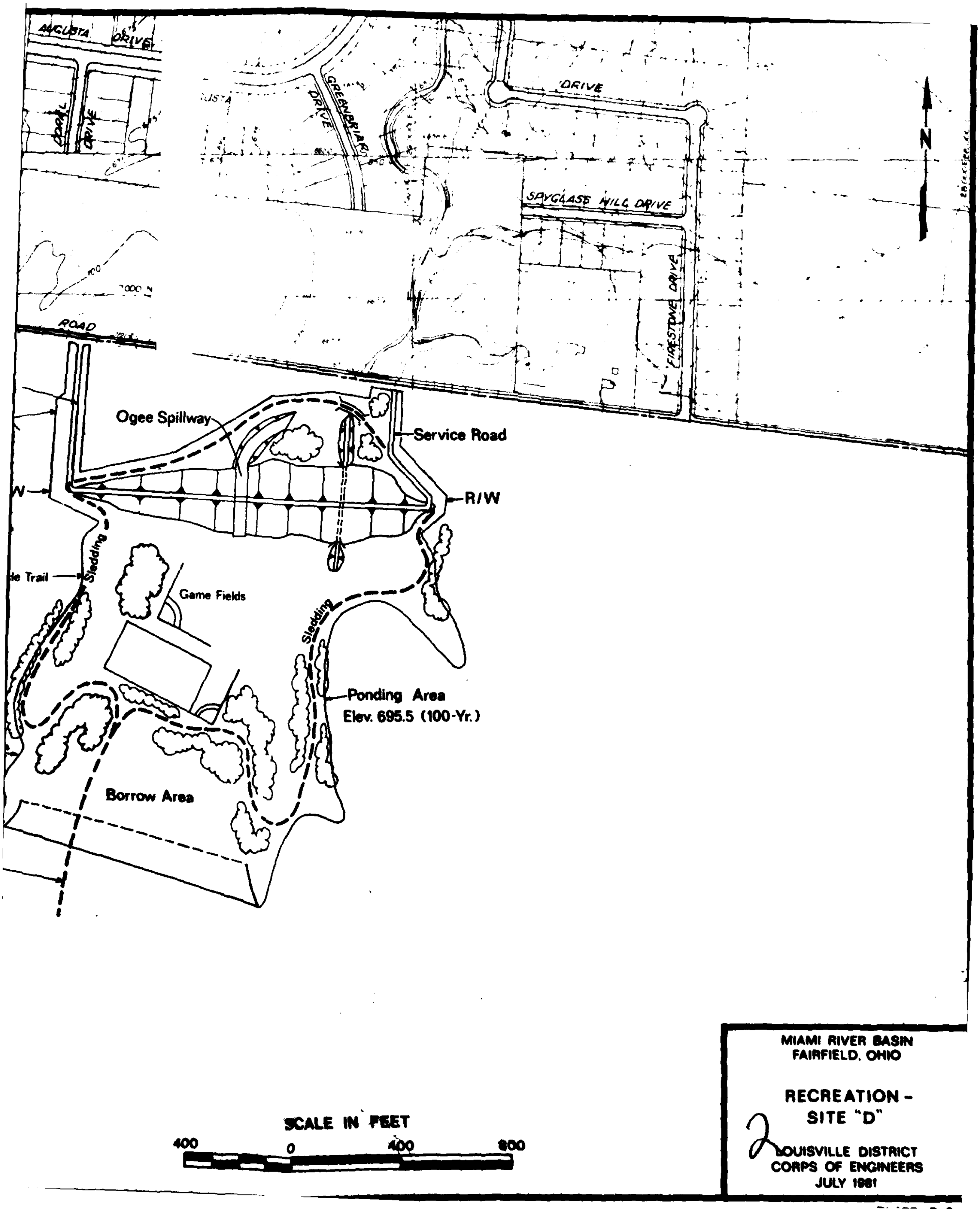
RECREATION - SITE "C"

2

LOUISVILLE DISTRICT
CORPS OF ENGINEERS
JULY 1981



AUGUSTA DRIVE
CORAL DRIVE
GREENBRIAR DRIVE
AVENUE
JACKSON ROAD
7000 N
24 000 E
23 000 E
Service Road
Parking
Ogee Spillway
Service Road
R/W
R/W
Sledding
Jogging / Bicycle Trail
Game Fields
Sledding
Ponding Area
Elev. 695.5 (100-Yr.)
Ponding Area
Elev. 695.5 (100-Yr.)
Borrow Area
Access Trail
SCALE IN FEET
400
0
400
800



AUGUSTA DRIVE
DORAL DRIVE
GREENBRIAR DRIVE
DRIVE
SPYGLASS HILL DRIVE
FIRESTONE DRIVE
ROAD
N
Ogee Spillway
Service Road
R/W
Sledding
Game Fields
Ponding Area
Elev. 695.5 (100-Yr.)
Borrow Area
SCALE IN FEET
400
0
400
800
MIAMI RIVER BASIN
FAIRFIELD, OHIO
RECREATION - SITE "D"
2
LOUISVILLE DISTRICT
CORPS OF ENGINEERS
JULY 1981

APPENDIX G

PRELIMINARY SECTION 404 EVALUATION

APPENDIX G

PRELIMINARY SECTION 404 EVALUATION

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APPENDIX G
PRELIMINARY SECTION 404 EVALUATION

The Clean Water Act (CWA) provides that the discharge of dredged or fill material into a navigable waterway be permitted at specific disposal sites by the Secretary of the Army acting through the Chief of Engineers under Section 404(a). Section 404(b) requires that each disposal site shall be specified by application of guidelines developed by the Administrator of the Environmental Protection Agency in conjunction with the Secretary of the Army. The requirements for the review of dredged material associated with a Federal project are prescribed in final regulations (33 CFR 209.145) dated 22 July 1974 concerning the policies, practices, and procedures to be followed by all Corps of Engineers installations in assessing Federal projects. These regulations were developed pursuant to Sections 313 and 404 of the CWA and Section 103 of the Marine Protection Research and Sanctuaries Act of 1972. The discharge of dredged or fill material into navigable waters must also be in accordance with final regulations published in Federal Register, Volume 42, No. 138 - Tuesday, 19 July 1977, which govern the issuance of Department of the Army permits for activities that occur in waters of the United States. A Corps project involving the discharge of dredged or fill material into waters of the United States must be evaluated in accordance with the interim final guidelines outlined in Federal Register, Volume 40, No. 193 - Friday, 5 September 1975 (40 CFR 230). These guidelines were developed by the Administrator, Environmental Protection Agency (EPA), in conjunction with the Secretary of the Army pursuant to Section 404(b) of the CWA. Construction of the considered Fairfield, Ohio flood control measures will require the discharge of dredged or fill material into the creek and tributaries and, therefore, an evaluation pursuant to Section 404(b) of the CWA is provided here.

1.0 CONSTRUCTION ACTIVITIES WHICH WOULD INVOLVE THE DISCHARGE OF DREDGED OR FILL MATERIAL INTO THE WATERCOURSE

The flood control plan at Fairfield in Butler County, Ohio provides a 100-year degree of protection, a degree of protection which would provide protection from a flood which would have a probability of occurring once in 100 years. The plan involves widening the bottom width from 35 to 60 feet along 1.37 miles of the stream. Included in the plan are three dry bed reservoirs located at High School Tributary, Winton Road Tributary and Pleasant Run Creek. The disposal area for the channelization site includes about 12 acres and will be used for approximately 92,000 cubic yards of spoil material. The project involves the discharge of dredged or fill material into the waterway, in those areas where the channel realignment will be performed, and where fill will be placed for the dams.

The material excavated at the channel site is expected to be principally silty clay with coarse gravel and sand, characteristic of the vicinity soils. The material used for reducing the channel erosion will be limestone riprap and concrete. The fill material for the dams for the three dry bed reservoirs will be primarily silty clay with some fine to medium sand.

2.0 PHYSICAL EFFECTS

Physical effects to aquatic ecology from discharge of dredged or fill material to the stream will result from the implementation of the considered plan. Impacts from the plan will occur as localized, temporary increases in suspended solids and subsequent turbidity within the water column. Other physical effects may include changes in bottom geometry and substrate composition that cause subsequent alterations in water circulation and the exchange of constituents between sediments and overlying water with subsequent alterations of biological communities.

3.0 CHEMICAL-BIOLOGICAL INTERACTIVE EFFECTS

Chemical-biological impacts involve contaminants present within the dredged or fill material. The principal concern arises from the open water discharge of any dredged material containing chemical contaminants which could potentially effect the water column and/or benthic communities. No significant problems of these sort are expected. Composition of the material associated with the channel improvement is silty clay with coarse gravel and sand. Silty clay with some fine to medium sand, which are natural to the area, and riprap and concrete from commercial, contaminant-free sources should present no significant adverse effects during construction of the reservoirs.

4.0 COMPARISON OF SITES

The dredged or fill material will cause no significant adverse effect to the environment since these materials will be obtained from within the immediate project vicinity or imported from pollution free sources.

5.0 WATER QUALITY CONSIDERATIONS

No long term adverse impact to water quality is expected to result from the considered alternatives. Short term turbidity and siltation will occur during construction. Construction practices and contract requirements will reduce these impacts.

6.0 SELECTION OF DISPOSAL SITES AND CONDITIONING OF DISCHARGING OR DREDGED OR FILL MATERIAL

Justification for disposal of these materials from constructing the considered alternatives lies in the project purpose: flood damage prevention. Disposal site selection is based on engineering feasibility and net benefits to be gained. The following objectives, established by EPA Guidelines [40 CFR 230.5 (a)], have a bearing on a considered discharge:

(1) Avoid discharge activities that significantly disrupt the chemical, physical, and biological integrity of the aquatic ecosystem of which aquatic biota, and substrate, and the normal fluctuation of water level are integral components;

(2) Avoid discharge activities that significantly disrupt the food chain, including alterations to or decrease in diversity of plant and animal species;

(3) Avoid discharge activities that inhibit the movement of fauna, especially their movement into and out of feeding, spawning, breeding, and nursery areas;

(4) Avoid discharge activities that destroy wetland areas having significant functions in maintenance of water quality;

(5) Recognize that discharge activities might destroy or isolate areas that serve the function of retaining natural high waters or flood waters;

(6) Minimize, where practicable, adverse turbidity levels resulting from the discharge of material;

(7) Minimize discharge activities that will degrade aesthetic, recreational, and economic values;

(8) Avoid degradation of water quality.

Regarding these objectives, much of this has already been discussed within the main text of this report. Impacts associated with placement of fill or dredged material for the purposes of new channel and dam constructio will be local and short term. Proper construction methods and practices will minimize adverse impacts.

The degradation of water uses at the intended disposal sites needs also to be considered. The following relate to impacts which would directly result from dredged or fill material disposal (during channel and dam construction) into the waterway.

(1) Municipal Water Supply Intake: There are no water supply intakes located in the vicinity of the proposed work.

(2) Shellfish: Shellfish populations would be disturbed by the channel excavation and dam construction. However, no significant shellfish population was found.

(3) Fisheries: Within the pertinent stream areas, these resources will be affected. Sediment burial and disturbance of habitat will affect spawning habitats and potential migration during construction.

(4) Wildlife: No long term adverse impact to wildlife is anticipated to result from fill or dredged material discharge.

(5) Recreation Activities: During the construction of the project fishing and other recreational activities will be adversely affected. Upon completion of the project and implementation of the recreation plan, the recreational activities of the area will be enhanced.

(6) Threatened or Endangered Species: No threatened and endangered species or the critical habitat thereof are known to exist within the study area. Material discharge for construction is anticipated to have no effect.

(7) Benthic Life: Due to the channel improvement and dam construction, benthic species will be impacted by construction. The channel excavation will involve disruption of 0.83 mile of channel area.

(8) Wetlands: No significant wetlands will be affected.

(9) Submersed Vegetation: No aquatic flora of significant biological productivity will be affected by the proposed plan.

(10) Size of Disposal Site: Twelve acres of land adjacent to the channel improvement will be used as a disposal site for the dredged material. The activity is for construction and the site size and actual location will be prescribed by engineering requirements.

Harmful effects to aquatic systems from disposal will be miminized by proper construction techniques or practices. Also, if necessary, dredged material could be covered and the ground water in the area monitored for contamination. This dredged material, though, is not anticipated to pose any problem.

CONCLUSION

The Environmental Protection Agency (EPA) 404(b) Guidelines (40 CFR 230) have been applied to those aspects of the project involving the discharge of dredged or fill material into waters of the United States. The eight objectives established by EPA to minimize effects on water quality and the aquatic ecosystem have been evaluated as part of this report. Performance of this considered project will be performed in accordance with those conditions.

DETERMINATION

A review of the considered actions in accordance with Section 404(b) Guidelines justifies the following determinations:

(1) An ecological evaluation has been made following the evaluation guidance in 40 CFR 230.4, in conjunction with the evaluation considerations in 40 CFR 230.5.

(2) Appropriate measures have been identified and incorporated within the consideratins to minimize adverse effects on the aquatic environment as a result of the discharges.

(3) Consideration has been given to the need for the activities, the availability of alternate sites, and methods of disposal that are less damaging to the environment and such water quality standards as are appropriate and applicable by law.

(4) The proposed discharge will not affect wetlands.

FINDINGS

After consideration of the foregoing evaluation, and in view of the above determination, it is found that the discharge sites for the Fairfield, Ohio project have been specified through application of the 404(b) Guidelines.

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